DINAMAP®

PRO 1000
SERVICE MANUAL

GE Medical Systems
Information Technologies

We bring good things to life.
gemedicalsystems.com

DINAMAP

PRO 1000 SERVICE MANUAL

DINAMAP® PRO 1000 Monitor

Service Manual

GE Medical Systems
Information Technologies

We bring good things to life.
gemedicalsystems.com

List of Effective Pages

Part No./Rev.	Page No.	Date of Latest Revision
2008072	All	Original Oct. 2001)

U.S. Patent 5,170,795
U.S. Patent 5,052,397
U.S. Patent 4,754,761
U.S. Patent 4,638,810
U.S. Patent 4,543,962
U.S. Patent 5,704,362
U.S. Patent 4,349,034
U.S. Patent 4,360,029
U.S. Patent 4,501,280
U.S. Patent 4,546,775
U.S. Patent 5,518,000
Patents Pending

CAUTION**:** Federal (U.S.A.) law restricts this device to sale by or on the order of a health care practitioner

The content of this document, including all figures and drawings, is proprietary information of General Electric Medical Systems *Information Technologies*, provided solely for purposes of operation, maintenance or repair of PRO 1000 Monitors. Dissemination for other purposes or copying thereof without the prior written consent of General Electric Medical Systems *Information Technologies*, Tampa, Florida, is prohibited. Illustrations may show design models; production units may incorporate changes.

© CRITIKON 2001 TAMPA, FL 33614
Printed in the U.S.A. All rights reserved.

United States
Critikon, L.L.C.
4502 Woodland Corporate Boulevard
Tampa, FL 33614

EU Representative
GE Medical Systems
Information Technologies GmbH
Munzinger Strasse,
Freiburg, Germany

TABLE OF CONTENTS

SECTION 1 INTRODUCTION
1.1. Scope of Manual....1-1
1.2. Manual Changes....1-2
1.3 Service Policy....1-2
1.3.1 Extended Warranties....1-2
1.3.2 Assistance....1-2
1.3.3 Service....1-3
1.3.4 Service Loaners....1-4
1.3.5 Repair Parts....1-4
1.3.6 Replacement Accessories....1-5
1.4 Product Description....1-5
1.4.1 General Description....1-5
1.4.2 Storage Batteries....1-6
Table 1-1 Specifications....1-7

SECTION 2. PRODUCT DESCRIPTION
2.1. Introduction....2-3
2.2. Product Configurations....2-3
2.3. Controls, Indicators, and Connectors....2-3
2.3.1. PRO Monitor Rear Panel Connections....2-4
2.3.2. Front Panel Controls and Indicators....2-5
2.4. Host Port Connector (rear panel)....2-7
2.4.1. Pin Assignments....2-7
2.5. Compatible Parts....2-8
2.6. Specifications....2-9
2.6.1. Power Requirements....2-9
2.6.2. Environmental....2-9
2.6.3. Mechanical....2-10
2.6.4. NIBP....2-10
2.6.5. Temperature....2-10
2.6.6. SpO2....2-11
2.6.7. ECG....2-12

SECTION 3. PRINCIPLES OF OPERATION
3.1. Introduction....3-3
3.2. Overall Principle Of Operation....3-3
3.2.1. Nellcor SPO2....3-3
3.2.2. Cuff Blood Pressure (BP) and Pulse....3-3
3.2.3. Alaris Oral and Rectal Thermometry....3-4
3.2.4. ECG with Heart Rate and Respiration....3-4

3.2.5. Host Communication Ports 3-4
3.3. Functional Description 3-5
3.3.1. PSU PWA 3-5
3.3.2. Mains Converter Module 3-6
3.3.3. Main Board 3-6
3.3.4. Keyboard PWA 3-7
3.3.5. ECG PWA 3-8
3.3.6. Pneumatic Control 3-8
3.3.7. LCD Assembly 3-9
3.3.8. Printer (Optional) 3-10

List of Figures

3-1 General System Diagram 3-12

SECTION 4. GENERAL MAINTENANCE

4.1. Introduction 4-3
4.2. Configuring the PRO 1000 Monitor for the First Time 4-3
4.2.1 Unpacking and Preparation for Installation 4-3
4.2.2 Set the Date and the Clock 4-5
4.2.3 Parameter Level Functional Testing 4-6
4.3. Periodic Maintenance 4-7
4.3.1. As Required 4-7
4.3.1.1 Integrity of Cuffs and Hoses 4-7
4.3.1.2 External DC Supply and Battery 4-7
4.3.1.3 Cleaning of Accessories 4-7
4.3.1.4 Long Term Storage 4-8
4.3.2 Annual Procedures 4-8
4.4. Care of Storage Batteries 4-9
4.4.1. Procedures for First Use 4-9
4.4.2 Battery Charging 4-9
4.5 Safety Resistance Testing 4-12
4.6. Alarm Code Interpretation 4-14
4.6.1. System Failures 4-14
4.6.2. Hardware Errors 4-15
4.6.3. Parameter Failures 4-15
4.6.3.1 ECG/RESP/TEMP Errors 4-15
4.6.3.2 NIBP Messages 4-15
4.6.3.3 Temperature Messages 4-16
4.6.3.4 SpO2 Messages 4-16
4.7. Service Mode Operation 4-16
4.7.1 SpO2 Tests 4-19
4.7.2 NIBP Tests 4-20
4.7.2.1 Leak Test 4-21
4.7.2.2 NIBP Calibration Check 4-23

4.7.2.3 Pressure Recalibration 4-24
4.7.2.4 Overpressure Test 4-25
4.7.3 EKG Tests 4-27
4.7.4 Temp Tests 4-28
4.7.5 Recorder Tests 4-30
4.7.6 Battery Tests 4-31
4.7.7 Test Failsafe Logic 4-32
4.7.8 Keypad LED Test 4-33
4.7.9 Keypad Key Test 4-33
4.7.10 Sound Test 4-33
4.7.11 Turn off the System 4-33
4.8 Service Mode Exit 4-33

Chapter 4 Appendices
Test Record ..... **Appendix A**
Monitor Configuration Log ..... **Appendix B**

SECTION 5 ASSEMBLY DRAWINGS & ELECTRICAL SCHEMATICS
Assembly Drawings (Monitor Assembly & Disassembly)
Front Case 1 ..... 5-1/2
Front Case 2 ..... 5-3/4
Rear Case 1 ..... 5-5/6
Rear Case 2 ..... 5-7/8

Electrical Schematics
ECG Board – 315589 ..... 5-9 through 5-18
Main Board – 315592 ..... 5-19 through 5-42
Power Supply Board – 315593 ..... 5-43 through 5-52
Keyboard 5-53/54
Probe Warmer 5-55/56

SECTION 1 INTRODUCTION

Contents

1.1. Scope of Manual 1-1
1.2. Manual Changes 1-2
1.3 Service Policy 1-2
1.3.1 Extended Warranties 1-2
1.3.2 Assistance 1-2
1.3.3 Service 1-3
1.3.4 Service Loaners 1-4
1.3.5 Repair Parts 1-4
1.3.6 Replacement Accessories 1-5
1.4 Product Description 1-5
1.4.1 General Description 1-5
1.4.2 Storage Batteries 1-6
Table 1-1 Specifications 1-7

This page intentionally left blank.

SECTION 1. INTRODUCTION

1.1
SCOPE OF MANUAL

This Service Manual provides service and parts repair information about the DINAMAP PRO 1000 Monitor. This manual is intended for use by trained service technicians who are familiar with electromechanical devices and digital and analog circuit techniques.

WARNING

CAUTION

To reduce the risk of electric shock, do not remove cover or back of any component. Refer servicing to qualified service personnel.

Only qualified service-technicians should perform repairs to this equipment.

Voltages dangerous to life exist in this unit. Take care when servicing power supply and display assembly.

For information about operating the Monitor in a clinical environment, refer to the separate Operation Manual.

This Service Manual consists of the following four sections:

- Section 1 describes this volume and tells you how to use it. Information is also provided about the physical and functional characteristics of the Monitor, and how to get assistance in the event the unit fails to function properly.

- Section 2 provides a general overview of the PRO 1000 including user controls, external connections, and product/ parameter specifications.

- Section 3 presents principles of operation for the Monitor, including an overall system description and principles of operation at the component level.

- Section 4 provides information about periodic and corrective maintenance of the Monitor. Procedures include module performance tests and calibration procedures. Information is provided to facilitate isolating faults to the subassembly level.
- Section 5 provides component information about the Monitor, including disassembly and reassembly procedures, parts lists, and assembly drawings, and electrical schematics.

1.2 MANUAL CHANGES

If, in the normal use of this manual, you notice errors, omissions, incorrect data, or if you can suggest comments that may help improve this manual, please complete the Publications Change Request form in the back of this manual. Submit the form to:

General Electric Medical Systems *Information Technologies*
Technical Publications
4502 Woodland Corporate Boulevard
Tampa, Florida 33614

Changes to the Service Manual, either in response to user input or to reflect continuing product improvements, are accomplished through reissue.

Changes occurring between reissues are addressed through Change Information Sheets and replacement pages. If a Change Information Sheet does not accompany your manual, the manual is correct as printed.

1.3 SERVICE POLICY

The warranty for this product is enclosed with the product in the shipper carton. All repairs on products under warranty must be performed or approved by Product Service personnel. *Unauthorized repairs will void the warranty.* Only qualified electronics service personnel should repair products not covered by warranty.

1.3.1 Extended Warranties

Extended warranties may be purchased on most products. Contact your Sales Representative for details and pricing.

1.3.2 Assistance

If the product fails to function properly, or if assistance, service or spare parts are required, contact Customer Support. Before contacting Customer Support, it is helpful to attempt to duplicate the problem and to check all accessories to ensure that they are not the cause of the problem. If you are unable to resolve the problem after checking these items, contact General Electric Medical Systems *Information Technologies*. Prior to calling, please be prepared to provide:

- product name and model number
- a complete description of the problem

If the repair parts or service are necessary, you will also be asked to provide

- the product serial number
- the facility's complete name and address
- a purchase order number if the product is to need of repair or when you order spare parts
- the facility's account number, if possible
- the 6-digit part number for spare or replacement parts

1.3.3 Service

If your product requires warranty, extended warranty or non-warranty repair service, call Customer Support and a representative will assist you. Estimates for non-warranty repairs are provided at no charge; however, the product must be sent to the General Electric Medical Systems Service Center in order to provide you with an estimate.

To facilitate prompt service in cases where the product has external chassis or case damage, please advise the Customer Support representative when you call.

The Customer Support representative will record all necessary information and will provide you with a Return Merchandise Authorization Number (RMA). Prior to returning any product for repair, you must have a RMA number. Contact technical support at **1-877-274-8456**

Monday through Friday, 8:00 a.m. to 7:00 p.m. EST, excluding holidays.

Packing Instructions
Follow these recommended packing instructions.

- Remove all hoses, cables, sensors, and power cords from the monitor before packing.
- Pack only the accessories you are requested to return; place them in a separate bag and insert the bag and the product inside the shipping carton.
- Use the original shipping carton and packing materials, if available.

If the original shipping carton is not available

- Place the product in a plastic bag and tie or tape the bag to prevent loose particles or materials from entering openings such as hose ports.

- Use a sturdy corrugated container to ship the product; tape securely to seal the container for shipping.
- Pack with 4 to 6 in. of padding on all sides of the product.

Insurance
Insurance is at the customer's discretion. The shipper must initiate claims for damage to the product.

1.3.4
Service Loaners

A loaner unit is provided at no charge during the service life of the product when we perform the repair service. Within 48 hours of your request, a loaner will be shipped to your facility.

- General Electric Medical Systems will pay shipping charges for a loaner sent to the customer for product repairs under the warranty.
- Shipping charges for a loaner sent to the customer for product repairs not under warranty will be billed to the customer.
- The customer will pay shipping charges to return a loaner.

All loaners provided to customers must be returned within the specified time stated on the loaner agreement or a rental fee will be incurred.

1.3.5
Repair Parts

Repair parts can be ordered from General Electric Medical Systems:

Via phone 1-877-274-8456, or

Via FAX 1-813-887-2430

Exchange replacement assemblies such as Circuit Board Assemblies also are available; ask the Customer Support representative for details.

Please allow one working day for confirmation of your order. All orders must include the following information.
- Facility's complete name, address, and phone number
- FAX number
- Your purchase order number
- Your account number

1.3.6
Replacement Accessories

Replacements such as hoses, sensors, etc. must be purchased from General Electric Medical Systems at 1-877-274-8456. Please have the 4-digit or 6-digit Reorder/Product Code of the item you wish to order, your purchase order and account number available.

1.4
PRODUCT DESCRIPTION

The Monitor and storage batteries are described below. Refer to Table 1-1 for specifications.

1.4.1
General Description

The DINAMAP PRO 1000 is designed for patient monitoring in acute care settings such as critical care, emergency room, radiology, labor and delivery, and operating room. It allows the clinician to view, record, and recall clinical data derived from each parameter. This data includes heart rate, respiration rate, oxygen saturation, noninvasive blood pressure, and temperature. Alarm limit conditions are also detected.

The recorder provides numeric and waveform printouts of monitored data. Up to 2 waveforms can be traced simultaneously. Each monitor can monitor one patient at the bedside.

Patient sensor connections are made at the side of the unit, and network and device connectors are at the rear.

Indicators for external DC operation (from AC mains), battery operation, and battery charging are at the front of the unit.

At the time of publication, the available functioning parameters included the following:

- NIBP
- Nellcor™ Pulse oximetry (SpO2)
- 3-lead ECG, with respirations
- 2-channel thermal recorder
- Alaris™ Oral and Rectal thermometry

The PRO 1000 Monitor series uses a TFT active-matrix-color liquid display.

The 10.4” diagonal display area contains 640 x 480 pixels and can display 262,144 colors simultaneously.

The LCD has the following specific characteristics. These are neither defects nor malfunctions:

- The ambient temperature may affect the display condition of the LCD.
- The LCD uses replaceable cold cathode tubes for backlighting. Optical characteristics, like luminance or uniformity will change during time.
- Uneven brightness and/or small spots may be noticed depending on different display patterns.

Other DINAMAP PRO 1000 features include:

- The ability to uses industry standard accessories
- Remote alarm capability
- An intuitive graphical user interface, with a simple Select Knob that moves the user through menus in a logical, and easy to understood format
- Five single-function keys for quick access to Alarm Silence, Record, Freeze, NIBP Start/Stop, and STAT NIBP

1.4.2 Storage Batteries

The PRO 1000 Monitor operates from AC mains power, an external DC power supply, or from the internal Nickel Metal Hydride storage battery. When external DC power becomes available, the system rapidly switches from battery power to external power.

Table 1-1. Specifications

Mechanical

Monitor	14.8 in (H) x 8.7 in (D) x 13.8 in (W) 37.0 cm (H) x 21.8 cm (D) x 34.4 cm (W)
Weight	Less than 12 lb (9.5 kg)

Environmental*

Operating Temperature	+41º F to +104º F (+5° C to +40° C)
Storage Temperature	-40º F to +158º F (-20º C to +60º C)
Operating Humidity	5% to 95%, noncondensing
Storage Humidity	5% to 95%, noncondensing
Operating Atmospheric Pressure	700 hPa to 1060 hPa
Storage Atmospheric Pressure	500 hPa to 1060 hPa

Electrical

Power Supply

The PRO 1000 Monitor can be operated from AC power, external DC power, or the rechargeable internal battery.

AC Input Voltage	120 - 240
AC Input Frequency	50 - 60 Hz
AC Input Power	60 - 120 Volt Amperes
AC Power Cable	Detachable, 16-gauge, 10 ft (3 meters) long
DC Input Voltage	18-24 V (supplied from a source conforming to IEC 601-1)
DC Input Power	60 Watts (supplied from a source conforming to IEC 601-1)
Internal Battery	12 Volts, nickel-metal-hydride (NiMH)
Battery Life	120 minutes (± 10 minutes) using fully charged internal battery, under specified load **
Charge time, internal charger	The PRO Monitor typically charges the battery to within 90% capacity within 3 hours.
Fuse (Battery)	10A 250V slow-blow

* The Monitor may not meet Performance Specifications (ANSI/AAMI SP10) if it is stored or used out of environmental specification ranges.

** Monitor shall be capable of operating on battery power for 2 hours minimum (NIBP @ 5 min., ECG/Resp. SpO^2, temp, dual channel recording once every 20 minutes.

SECTION 2. PRODUCT DESCRIPTION

CONTENTS

2.1. Introduction 2-3
2.2. Product Configurations 2-3
2.3. Controls, Indicators, and Connectors 2-3
2.3.1. PRO Monitor Rear Panel Connections 2-4
2.3.2. Front Panel Controls and Indicators 2-5
2.4. Host Port Connector (rear panel) 2-7
2.4.1. Pin Assignments 2-7
2.5. Compatible Parts 2-8
2.6. Specifications 2-9
2.6.1. Power Requirements 2-9
2.6.2. Environmental 2-9
2.6.3. Mechanical 2-10
2.6.4. NIBP 2-10
2.6.5. Temperature 2-10
2.6.6. SpO_2 2-11
2.6.7. ECG 2-12

This page intentionally left blank.

SECTION 2. PRODUCT DESCRIPTION

2.1. INTRODUCTION

DINAMAP® PRO Monitors provide non-invasive determination of systolic blood pressure, diastolic blood pressure, mean arterial pressure, pulse rate, 3-lead ECG, temperature, and oxygen saturation. These portable AC and DC operated monitors are primarily intended for use in hospital acute care settings such as outpatient surgery, accident and emergency, labor and delivery, GI/endoscopy, and medical/surgical units.

2.2. PRODUCT CONFIGURATIONS

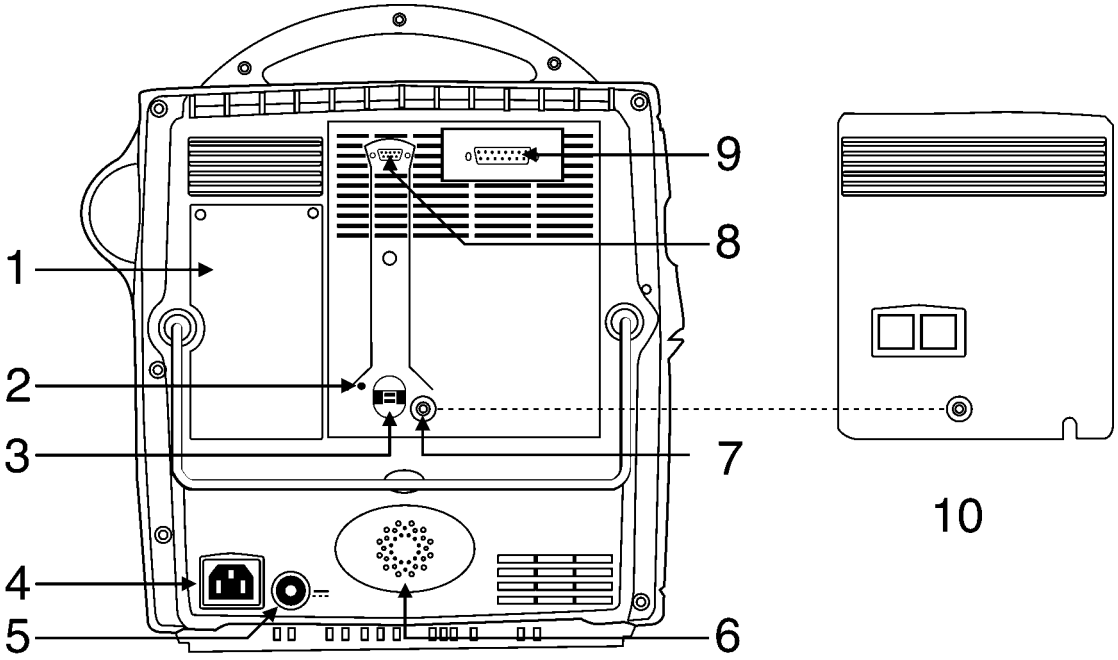
Each PRO Monitor is supplied with an accessory pack. The contents of the pack vary according to model. Unpack the items carefully, and check them against the checklists enclosed within the accessory boxes. If an accessory is missing or if an item is in a nonworking condition, contact Critikon immediately.

It is recommended that all the packaging be retained, in case the PRO Monitor must be returned for service in the future.

2.3. CONTROLS, INDICATORS, AND CONNECTORS

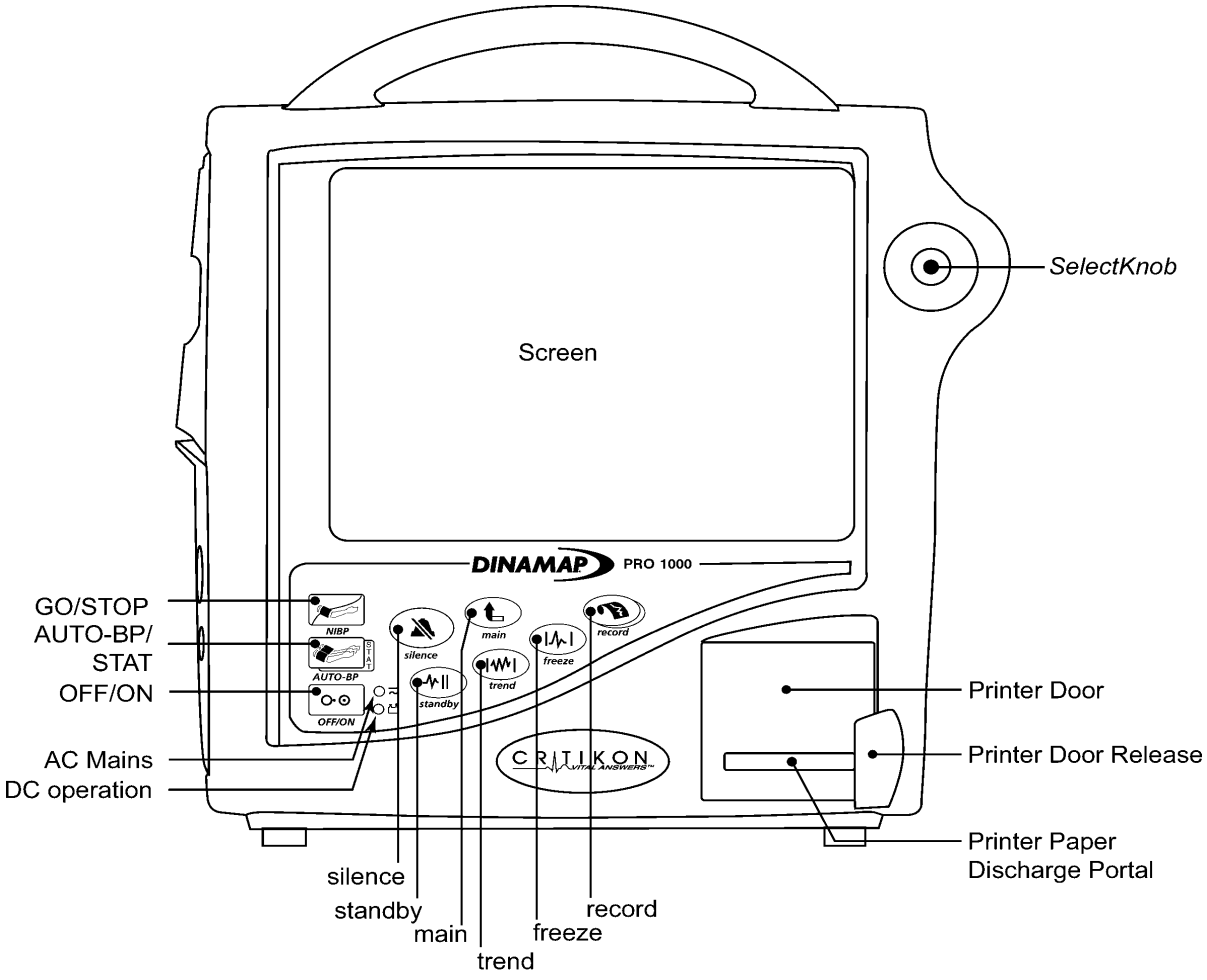
Descriptions of the items shown are listed on the pages that follow. For symbol definitions, refer to paragraph: 2.3.2 of this section.

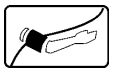
2.3.1. PRO Monitor Rear Panel Connections



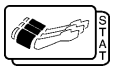
1. Serial Number/ Manufacturer labeling
2. Earth Ground (safety test compatible)
3. Battery fuse (10A 250V)
4. Mains input (Used to connect to AC power supply)
5. External DC Input: 18-24 VDC only.
6. Main speaker opening.
7. Socket to secure removable rear cover (see 10)
8. DB9 connection used for Host Communication.
9. DB15 used for Host Communication/ remote alarm.
10. Removable rear protective cover.

2.3.2. Front Panel Controls and Indicators





GO/STOP – Starts and stops any determination of noninvasive blood pressure.

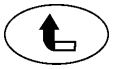


AUTO-BP/STAT – Dual-function hardkey. Starts and stops **auto BP** determinations by a single-press and gives you access to change the NIBP cycle time. Starts and stops **stat** determinations with a double-press (5 minutes of continuous NIBP cycles.)

OFF/ON – Turns Monitor off and on.

Silence – Temporarily silences alarms; acknowledges alarming crisis conditions.

Standby – Enters and exits standby mode.



Main – Closes the menu system and takes you back to the main screen.

Trend – Enters and exits trends (view patient trends data.) This hardkey can be configured through config mode two ways: to view mini trends or to view full trends.

Freeze – Captures up to 16.8 seconds of waveforms on the screen (seconds vary depending on the chosen sweep speed.)

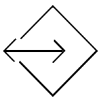
Record – Prints with a single-press for a snapshot (timed recording) and a double-press for a continuous recording of the chosen waveforms.

Optional Components

Note: Interconnected equipment must be installed by a qualified service person.

Symbols

CE Mark


External Communications Port Connector

Attention, consult accompanying documents

Type CF applied part

Battery in use

Canadian Standards Association

Storage temperature

External AC or DC power indicator

External DC power input

External AC power input

Keep away from heat

This way up

Keep dry

Fragile, handle with care

SN Serial number

REF Catalog number

Predictive temperature

Functional earth terminal (ground lug)

Serial Port 1

Serial Port 2

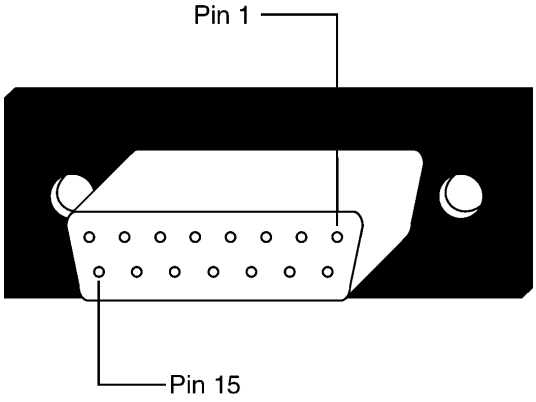
Ethernet Connector

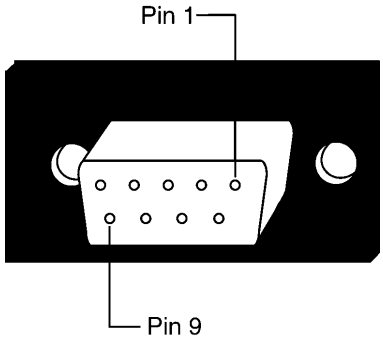
2.4. HOST PORT CONNECTORS (BENEATH REAR PANEL)

All host port signals are NON-ISOLATED and should be connected to equipment conforming to IEC 601-1-1 ONLY. Where isolation of data communication is required, the Critikon isolated level converter should be used. If external alarm control is required, Critikon part number 487208 (Isolated Remote Alarm Cable Assembly) should ALWAYS be used. Please refer to the Information Sheet included with the isolated remote alarm cable for operational details.

> **Note**: When using remote alarm, the PRO Monitor should be considered the primary alarm source. The secondary alarm is used for secondary purposes only.

2.4.1. DB15/ DB9 Connector Pin Assignments





Pin	Function
1	Ground
2	TX2_Inverted TTL Data
3	RX2_Inverted TTL Data
4	AUX5V (600mA max.)
5	AUX12V (250mA max.)
6	Serial Level Control (High=TTL Low=-RS-232)
7	Ground
8	Remote Alarm (open collector, 75mA Max Sink)
9	No Connection
10	No Connection
11	TX2_RS232
12	Port Enable Control <low=port 2> (when in use, DB9 4 & 5 disabled)
13	RX2_RS232
14	No connection
15	No connection

Pin	Function
1	Ground
2	TX1 Inverted TTL Data
3	RX1
4	TX2
5	RX2
6	+5V (600mA Max)
7	+12V (400mA Max)
8	No Connection
9	No Connection

2.5. COMPATIBLE PARTS

The following parts are available from Customer Service.

Description of Compatible Part	Code
SOFT-CUF™, Cuff, Infant	2500
SOFT-CUF™, Cuff, Child	2501
SOFT-CUF™, Cuff, Small Adult	2502
SOFT-CUF™, Cuff, Adult	2503
SOFT-CUF™, Cuff, Large Adult	2504
SOFT-CUF™, Cuff, Thigh	2505
SOFT-CUF™, Cuff, Neonatal type 1	2521
SOFT-CUF™, Cuff, Neonatal type 2	2422
SOFT-CUF™, Cuff, Neonatal type 3	2523
SOFT-CUF™, Cuff, Neonatal type 4	2524
SOFT-CUF™, Cuff, Neonatal type 5	2525
DURA-CUF® Cuff, Infant	2783
DURA-CUF® Cuff, Child	2781
DURA-CUF® Cuff, Small Adult	2779
DURA-CUF® Cuff, Adult	2774
DURA-CUF® Cuff, Large Adult	2791
DURA-CUF® Cuff, Thigh	2796
DURA-CUF® Cuff, Assortment cuff pack	2699
DURA-CUF® Cuff, Child pack	2697
CLASSIC-CUF™ , Cuff, Infant	2618
CLASSIC-CUF™, Cuff, Child	2613
CLASSIC-CUF™, Cuff, Small Adult	2608
CLASSIC-CUF™, Cuff, Adult	2603
CLASSIC-CUF™, Cuff, Large Adult	2643
CLASSIC-CUF™, Cuff, Thigh	2648
CLASSIC-CUF™, Cuff, Neonatal type 1	2638
CLASSIC-CUF™, Cuff, Neonatal type 2	2633
CLASSIC-CUF™, Cuff, Neonatal type 3	2628
CLASSIC-CUF™, Cuff, Neonatal type 4	2623
CLASSIC-CUF™, Cuff, Neonatal type 5	2619
12 Foot (approx. 3.7 meters) Long Adult / Pediatric Hose	107365
24 Foot (approx. 7.3 meters) Long Adult / Pediatric Hose	107366
12 Foot (approx. 3.7 meters) Long Neonatal Hose	107368
12 Foot (approx. 3.7 meters) Long A/P Hose Quick Disconn.	107368
IVAC** Oral Temperature Probe	088012
IVAC** Rectal Temperature Probe	088013
IVAC** Temperature Probe Covers	088015
DINAMAP® PRO Monitor Operation Manual	776995*
DINAMAP® PRO Monitor Service Manual	777358*
Accessory Pole/Basket/Base	3215
Printer Paper (Box of 10)	089100
Power Cable	316579
NELLCOR*** SpO_2 Extension Cable	SCP10*
NELLCOR Finger Sensor	DS100A
NIBP Calibration Kit	320246

* PRO Monitor unique parts

** IVAC is a trademark of ALARIS Medical Systems

*** NELLCOR is a trademark of Mallinckrodt, Inc.

2.6. SPECIFICATIONS

CE 0086	This product conforms with the essential requirements of the Medical Device Directive. Accessories without the CE Mark are not guaranteed to meet the Essential requirements of the Medical Device Directive.
IPX1	The PRO Monitor is protected against vertically falling drops of water and conforms to the IEC 529 standard at level of IPX1. No harmful effects will come of vertically falling drops of water making contact with the monitor.

2.6.1. Power Requirements

MAINS	Protection against electrical shock - Class 1
AC INPUT VOLTAGE	115 / 230 VAC, 50 / 60 Hz (nominal), 90 ~ 253 VAC, 47 ~ 63 Hz (range)
ALTERNATE SOURCES	Protection against electrical shock – Class 1
DC INPUT VOLTAGE	24 VDC (nominal), 12-30 VDC from supplied power converter
EXTERNAL DC FUSE	Internal, auto-resetting.
BATTERY	12 volt, 2.3 amp-hours. Protected by auto-resetting fuse. Minimum operation time: 2 hours (5 minute auto cycle with adult cuff at 25°C (77°F) with power save mode enabled) from full charge. Time for full recharge: 1 hr 50 min from full discharge when the Monitor is switched off and 8 hrs when Monitor is switched on.

2.6.2. Environmental

OPERATING TEMPERATURE	+ 5° C to + 40° C (+ 41° F to + 104° F)
OPERATING ATMOSPHERIC PRESSURE RANGE	700 to 1060 hectoPascal
STORAGE TEMPERATURE	– 20° C to + 50° C (– 4° F to + 122° F)
STORAGE / TRANSPORTATION ATMOSPHERIC PRESSURE	500 to 1060 hectoPascal
HUMIDITY RANGE	0 % to 95 % non-condensing
RADIO FREQUENCY	Complies with IEC Publication 601-1-2 (April 1993) Medical Electrical Equipment, Electromagnetic Compatibility Requirements and Tests, and CISPR 11 (Group 1, Class A) for radiated and conducted emissions.
INGRESS OF LIQUIDS	The Monitor is protected against vertically falling drops of water and conforms with the IEC 529 standard at level of IPX1. No harmful effects will come of vertically falling drops of water making contact with the Monitor.

2.6.3. Mechanical

DIMENSIONS	Height Width Depth	9.8 in. (25.0 cm) 9.8 in. (24.8 cm) 6.9 in. (17.5 cm)
WEIGHT including battery	7.8 lb (3.5 kg)	
MOUNTINGS	Self-supporting on rubber feet or pole mountable	
PORTABILITY	Carried by recessed handle or pole mounted	
CLASSIFICATION INFORMATION	Mode of Operation: Continuous Degree of Protection against harmful ingress of water: Drip-proof IPX1	

2.6.4. NIBP

CUFF PRESSURE RANGE	Adult Neonate	0 mmHg to 290 mmHg 0 mmHg to 145 mmHg	
DEFAULT TARGET: CUFF INFLATION	Adult Neonate	150 ± 15 mmHg 110 ± 15 mmHg	
TARGET CUFF INFLATION ADJUSTMENT RANGE	Adult Neonate	100 to 250 mmHg 5 mmHg increments 100 to 140 mmHg 5 mmHg increments	
BLOOD PRESSURE DETERMINATION TIME	Adult Neonate	120 seconds maximum 85 seconds maximum	
PULSE RATE RANGE	Adult Neonate	30 – 200 BPM ±3% 30 – 220 BPM ±3%	
OVERPRESSURE CUT-OFF	Adult Neonate	300 – 330 mmHg 150 – 165 mmHg	
BLOOD PRESSURE MEASUREMENT RANGES	Systolic mmHg	MAP mmHg	Diastolic mmHg
Adult	30 - 290	20 – 260	10 - 220
Neonate	30 - 140	20 – 125	10 - 110
BLOOD PRESSURE ACCURACY	Meets AAMI/ANSI standard SP-10 AAMI/ANSI standard: ± 5 mmHg mean error Intra-arterial method: ± 8 mmHg standard deviation		
PULSE RATE ACCURACY	± 3.5 percent		

2.6.5. Temperature

SCALES	Celsius	Fahrenheit
RANGE Max	42.2 °Celsius	108.0° Fahrenheit
Min	31.6°Celsius	88.9° Fahrenheit
MONITOR MODE ACCURACY	± 0.1°C	± 0.2°F (when tested in a calibrated liquid bath; meets ASTM E1112, Table 1, in range specified)
PREDICTIVE MODE ACCURACY	± 0.6°C	± 1.0°F
DETERMINATION TIME	Less than 60 seconds	

2.6.6. SpO_2

SpO_2 RANGE AND ACCURACY	adult/neonate: 70% to 100% ± 3.5 digits
	adult/neonate: 0% to 69% ± (unspecified)
PULSE RATE RANGE AND ACCURACY	30 BPM - 250 BPM ± 3 BPM
SATURATION PITCH INDICATOR	Pitch changes with saturation Volume selectable from 0 (off) to 9
WAVEFORMS	Pulse plethysmograph waveform on LCD gain compensated
SENSOR CONNECT / DISCONNECT FROM PATIENT	The monitor detects the attachment or disconnection of a sensor from the patient within 15 seconds
SENSOR CONNECT / DISCONNECT FROM MONITOR	The monitor detects the attachment or disconnection of a sensor from the Monitor within 5 seconds
PULSE DETECTION	The monitor detects a pulse or enters a no signal state within 15 seconds of being attached to the patient
LOSS OF PULSE	The monitor detects loss of pulse from patient and enters a no signal state within 10 seconds

NELLCOR SENSORS

ADULT ACCURACY (70% - 100%)	**ACCURACY**
OXICLIQ-P pediatric sensor	2.5 digits
OXICLIQ-I infant sensor	2.5 digits
OXICLIQ-N neonatal/adult sensor	2.5 digits
OXICLIQ-A adult sensor	2.5 digits
OXIBAND pediatric/infant sensor	3.0 digits
OXIBAND adult/neonatal sensor	3.0 digits
DURA-Y ear clip	3.5 digits
REFLECTANCE sensor	3.5 digits
DURASENSOR adult	3.5 digits
PEDI-CHECK pediatric spot-check clip	3.5 digits
OXISENSOR II D-20 pediatric sensor	2.0 digits
OXISENSOR R-15 adult nasal sensor	3.5 digits
OXISENSOR II D-25 adult sensor	2.0 digits
OXISENSOR II N-25 neonatal/adult sensor	2.0 digits
OXISENSOR II I-20 infant sensor	2.0 digits
OXISENSOR II D-25L adult sensor, long cable	2.0 digits

Neonatal Accuracy **NOTE: Refer to NELLCOR sensor specifications**	When sensors are used on neonatal subjects as recommended, the specified accuracy range is increased by ± 1 digit to account for the theoretical effect on oximeter measurements of fetal hemoglobin in neonatal blood, e.g., N-25 accuracy on neonates is ± 3, rather than ± 2.

2.6.7 ECG

Leads Available	3-lead configuration: I, II, III, MCL1
QRS amplitude	0.2 to 5.0 mV
QRS duration range	15 to 200ms (does not reject 10 ms, 1mV QRS)
Heart rate accuracy	10 to 300 (adult) / 10 to 350 (neonate) beats/min ±3 beats/min or 3% of reading, whichever is greater
Heart rate resolution	1 beat/min
Bandwidth: Display/Recorder	 0.5 to 40 Hz 0.05 to 40 Hz 0.05 to 100 Hz
Standardizing voltage	1 mV marker
Common mode rejection	1 mV RTI or 10 mm peak-to-peak maximum displayed noise allowed with 20 Vrms, 50-60 Hz input
Input impedance:	> 2.5 MΩ @ 10 Hz
60 Hz tolerance	Up to 10 mV (with artifact detector off) Up to 300µV (at 1 mV QRS and artifact detector on)
Pacemaker detection/rejection Pacer amplitude Pacer width	 ± 2 mV to ±700 mV 0.1 ms to 2 ms
With under or overshoot of Pacer amplitude Pacer width	2 mV, 70 ms duration ± 2 mV to ± 700 mV 0.1 ms to 2 ms
Tall T wave rejection:	100%
Lead off sensing current:	<0.1 µA DC signal leads < 1 µA DC driven lead
Time to alarm:	High heart rate < 10 s per AAMI EC13 – 1992 Low heart rate < 10 s per AAMI EC13 – 1992 Cardiac standstill < 10 s per AAMI EC13 – 1992 Tachycardia waveforms < 10 s per AAMI EC13 - 1992

SECTION 3. PRINCIPLES OF OPERATION

CONTENTS

3.1. Introduction 3-3
3.2. Overall Principles Of Operation 3-3
3.2.1. Nellcor SPO2 3-3
3.2.2. Cuff Blood Pressure (BP) and Pulse 3-3
3.2.3. Alaris Oral and Rectal Thermometry 3-4
3.2.4. ECG with Heart Rate and Respriation 3-4
3.2.5. Host Communication Ports 3-4
3.3. Functional Description 3-5
3.3.1. PSU PWA 3-5
3.3.2. Mains Converter Module 3-6
3.3.3. Main Board 3-6
3.3.4. Keyboard PWA 3-7
3.3.5. ECG PWA 3-8
3.3.6. Pneumatic Control 3-8
3.3.7. LCD Assembly 3-9
3.3.8. Printer (Optional) 3-10

LIST OF FIGURES

3-1 General System Diagram 3-11/12

This page intentionally left blank.

SECTION 3. PRINCIPLES OF OPERATION

3.1 INTRODUCTION

This section provides overall theory of operation and functional description of the DINAMAP PRO 1000 (hereinafter referred to as PRO monitor). The PRO monitor has Blood Pressure (BP), Pulse, Temperature, SPO2, and ECG monitoring capability. The printer module is optional.

3.2 OVERALL PRINCIPLES OF OPERATION

The following paragraphs provide a general system interface relationship. The general block diagram is located in Figure 3-1.

The PRO monitor is a portable unit that receives input power from an external AC source, external DC source, or internal rechargeable battery.

When the ON/OFF button is pressed, the Main Board is brought out of a sleep mode and turns on the power regulators. The power regulators provide conditioned power from one of the input power sources: AC Mains, External DC, or the internal battery. The regulated power is routed to the Printed Wiring Assemblies (PWAs) via the cable harnesses. Once the PRO monitor is energized, a self-test is performed. The self-test automatically tests the main functions of the PRO monitor. Failure of the self-test will set the PRO monitor into a fail-safe mode with an audio alarm.

Under normal operating condition, the PRO monitor is ready to monitor the patient vital signs using five external attachments: two temperature probes (rectal and oral), SPO2 sensor, ECG leads, and cuff. Interface with a central station or other device is accomplished through the 9-pin host communication port or 15-pin wireless communication port on the back of the PRO monitor.

3.2.1 Nellcor SPO2

When the SPO2 sensor is attached to the SPO2 connector and patient, it senses the heart rate and oxygen saturation. These analog signals are routed to the SPO2 PWA. The analog signals are analyzed on the SPO2 PWA. The results are digitized and sent to the Main Board via opto couplers. The couplers provide for patient isolation as well as serial data interface. The Main Board routes the data to the appropriate displays and/or printer.

A reset signal to the SPO2 PWA is also provided for power up sequencing.

3.2.2 Cuff Blood Pressure (BP) and Pulse

When the cuff and hose are attached to the PRO monitor and Non-Invasive Blood Pressure (NIBP) determination is initiated, the pump inflates the cuff. Pressure transducers PT1 and PT2 monitor pressure information. The pneumatic manifold

has two valves, which are used to deflate the cuff. Valve control is through the Main Board. Determinations are made for the systolic BP, diastolic BP, pulse rate, and Mean Arterial Pressure (MAP). The results are displayed on the front panel Liquid Crystal Display (LCD).

If an over-inflation condition occurs, it is detected by PT2, resulting in assertion of OVERPRESSURE. The OVERPRESSURE signal is routed to the PVM to release the air pressure. The Main Board also generates an alarm condition with the speaker sounding and a message in the LCD.

3.2.3 Alaris Oral and Rectal Thermometry

The PRO monitor has two temperature channels, one each for oral and rectal determinations. When a TEMPERATURE probe is attached to the temperature connector and patient, TEMP input is routed to the Main Board. This input represents the temperature to be measured. The Main Board converts the TEMP signal to a digital signal. During the conversion, the Main Board determines the patient temperature using a predictive or monitor mode algorithm depending on user setup. The patient temperature is distributed as a digital signal to the LCD display or printer.

The PRO monitor has a probe check feature to help prevent erroneous temperature readings stemming from using the wrong probe for determinations (i.e. oral probe for rectal determination and vice versa.)

3.2.4 ECG with Heart Rate and Respiration

The ECG parameter provides electrocardiographic waveform in a 3-electrode configuration. The 3-electrode configuration derives waveforms for leads I, II, or III. It includes a waveform cascade feature and can display one waveform as the primary lead.

Breath rate is calculated by measuring the thoracic impedance between two electrodes. As the patient breathes, the movement of the chest changes the measured impedance to produce the respiration rate.

3.2.5 Host Communication Ports

There are two Host Comm Ports provided on the back panel of the PRO monitor. The DB9 connector provides +5V(600mA Max), +12V(400mA Max), and two channels of TTL compatible communications. The DB15 connector provides +5V(600mA Max), +12V(250mA Max), Remote Alarm Signal, and a TLL/RS-232 selectable communication channel.

Note: When the DB15 port is enabled, channel 2 of the DB9 port is disabled.

The Host Comm Ports are used to interface the PRO monitor with other electronic devices (a central nurse’s station or remote alarm device.) Signals can be sent to the PRO monitor to initiate blood pressure determinations and other functions. Patient data can also be retrieved through this port. The DB9 connector should be used with Critikon Adapters ONLY. The host port signals on the DB15 connector are NON-ISOLATED and should be connected to equipment conforming to IEC

601-1-1 ONLY. Where isolation of data communication is required, the Critikon isolated level converter should be used. If external alarm control is required, Critikon part number 487208 (Isolated Remote Alarm Cable Assembly should ALWAYS be used. Please refer to the Information Sheet included with the isolated remote alarm cable for operational details.

Note: When using remote alarm, the PRO monitor should be considered the primary alarm source. The secondary alarm is used for secondary purposes only.

3.3 FUNCTIONAL DESCRIPTION

The following paragraphs provide the functional interface relationship. The PRO monitor contains a number of electrical & electro-mechanical assemblies. These assemblies are:

- Power Supply Unit (PSU) PWA
- PSU Module
- Main Board
- Keyboard PWA
- ECG PWA
- Pneumatic control device
- Liquid Crystal Display (LCD) Assembly
- Printer PWA w/printer (optional)

3.3.1 PSU PWA

The PSU supplies regulated DC power to PRO monitor. The PSU PWA is designed to operate from the output of the AC MAINS PSU module (+24VDC), EXTERNAL DC (+24VDC to +28VDC) source, or from an internal NiMH rechargeable battery (+12VDC). The PSU will automatically select the power source based on the following priority:

- Valid EXTERNAL DC input = +16VDC (If greater than or equal to output of Mains Converter)
- Valid AC MAINS input
- Valid NiMH battery

The PSU PWA converts the selected power source into the following main voltages:

- VRAW1 (14.4VDC)
- VRAW2 (14.4VDC)
- VBAT

The +12V printer supply voltage is down converted from VRAW1 and maintained by a boost regulator to +12V when VRAW1 falls under 12V. ANA+ is regulated to +14.4VDC from VRAW2 by a MAX668 step up controller. AUX +12V is down

converted from ANA+ using an LM340 regulator. ANA- is down converted from VRAW2 to –14.4VDC using a LM2594 step down regulator.

VBAT is the battery voltage protected by a 500mA auto-reset fuse. It is also used to power the failsafe alarm circuits on the Main Board.

The PSU PWA contains firmware that reports the charge status of the battery to the secondary processor on the main board. The secondary processor will charge the battery at the fastest rate allowable while keeping the PRO monitor power consumption under 60W.

The fan control circuitry is located on the PSU PWA and is powered by VRAW1. The circuitry is thermally controlled and will start the fan when the thermistor (TH1) reaches approximately 50°C.

The host communication port control circuitry selects whether channel 2 is routed to the Comms connector (DB-9) or the wireless connector (DB-15). If channel 2 is routed to the wireless connector, it can be configured for RS-232 or inverted TTL signals. Channel 1 is only available on the Comms connector as inverted TTL.

3.3.2 Mains Converter Module

The Mains converter module is an AC Mains to DC converter. The module receives AC power from the mains input connector. When AC INPUT is applied to the module, the module AC/DC Converter changes the AC INPUT supply via rectifier circuit to a high voltage DC. The DC power is then routed through a high frequency switching converter and regulated to 24 VDC. This supply is connected to the PSU PWA for further regulation. The PSU only selects this source when DC Output is greater than +16VDC AND greater than the EXTERNAL DC input voltage.

3.3.3 Main Board

The Main Board is configured with Flash ROM, EEPROM, RAM, 16-bit ADC, Primary Processor, Secondary Processor, SPO2 Module, and Temperature Module. The Primary Processor operates from a 4.9152 MHz crystal stepped up to 49.152 MHz. The Primary Processor services and controls the RAM, Flash ROM, EEPROM, the physiological interface modular devices and display backlighting. The Secondary Processor monitors the power supply circuit, controls the power-on/off sequences, performs watchdog task on itself and the Primary Processor, monitors signals within the NIBP module, and monitors board temperature. The Secondary Processor monitors the power supply circuit and controls the battery back up enable when no external sources are present and will shut down the unit when the battery is exhausted. It will enable the battery charging circuit based on the battery charge status, unit power consumption, and the availability of an external power source.

The SPO2 processor monitors pulse oximetry signal and passes the processed signals to the SPO2 interface chip. The interface chip takes the signals and derives the oxygen saturation and heart rate data and converts them into serial data. The serial data from the SPO2 interface chip are send across an isolation barrier (optocouplers) and passed to the Primary Processor via a dual-channel UART.

The Temperature Module is a dual channel system. Two IVAC probes and the calibration resistor chain are connected into a multiplexer that is controlled by a single chip micro controller. The micro controller will then switch the output of the multiplexer between the calibration chain and the two probes. The multiplexer output is buffered, level shifted and amplified before being connected to a MAX1241 12 bit serial DAC, which is read by the microcontroller. The microcontroller will compute the resistance for each probe (and associated leads) and transmit both resistance values to the Primary Processor in a 34-bit data stream. A switch controls each probe; the Primary Processor will interpret the status of the switches, and select the appropriate part of the data stream from the temperature circuit.

The Random Access Memory (RAM) is comprised of a SRAM chip and two SDRAM chips. The 512 Kbytes of battery-backed SRAM is provided to store trend data and to provide space for working algorithms and is accessed on bits D[0:15] of the data bus. The two 64 Mbit SDRAM chips are set up to form a 32 bit data bus on bits D[31:0] that is used for running the program and working memory. This gives 16Mbytes of memory with an access time of less that 20ns. The program is loaded (including the boot code) from the 16 bit FLASH Read Only Memory (ROM). The Electronically Erasable Programmable Read Only Memory (EEPROM) is an 8 bit chip that is used to store the calibration and other “setting” variables that have to be maintained in the event of a complete power failure.

If a hardware or software error causes a malfunction, its watchdog will provide an internal and external RESET(L) signal. The FAILSAFE controller will cause the FAILSAFE(L) signal to go low. This signal passes to the Secondary Processor, which will disable the Primary Processor’s power supplies, thus turning it off. FAILSAFE(L) also passes to the PAL (NIBP control logic), which will dump the cuff pressure. The system is left in a safe state but is remains on to enable the Secondary Alarm to stay active. The Primary Processor monitors the activity of the secondary via its handshaking communications. If the Secondary fails, the Primary can assert the FAILSAFE line by overriding the FAILSAFE controller. The Secondary Alarm is a hardwired alarm that will sound in the event of a FAILSAFE condition. Pressing the OFF-key can immediately reset this alarm although it will eventually time-out after about 10 minutes.

3.3.4 ECG PWA

The ECG PWA accepts signals from a 3-electrode cable for processing. The 3-electrode cable provides a single lead configuration with Lead I, Lead II, or Lead III available. The cables specified by Critikon are shielded and provide 1k-Ohm series (safety) resistors internal to the cable that are part of the current limiting defibrillator protection circuitry. Gas surge arrestors on the PWA provide lead-to lead defibrillator protection. In addition, a passive R/C network located on this PWA provides the first stage of high frequency filtering for EMC and ESU interference rejection. Two leads are selected for ECG measurement by a multiplexer (LS0, LS1 signal controlled) and passed to a differential amplifier. A second multiplexor selects the third electrode (the one not sent to the differential amplifier) and drives

the signal with an amplified and inverted version of the common mode voltage of the two measuring electrodes. This feedback action cancels most of the common mode signal applied to the differential amplifier. The output signal from the differential amplifier is then routed to bandpass filter and pacemaker detection circuit.

The ECG PWA uses the pacemaker detection circuit to prevent pacemaker signals from interfering with heart rate measurements. The ECG signals are sent through a bandpass filter designed to pass pacemaker pulses in preference to ECG signals. The filter output is applied to a comparator that asserts an output signal when the input signal exceeds its positive or negative threshold. This output signal is used by the controller to blank the ECG signal channel and alert the host to the presence of a pacemaker pulse. The filtered ECG signal is routed to the A/D converter for transfer to the Main Board.

The respiration circuit uses the ECG electrodes to measure respiration rate. This is achieved by applying an excitation current (61.5 kHz, well outside the bandwidth of normal ECG signals) generated by a square wave switch onto two selected electrodes. The measured voltage drop is filtered, the baseline component removed, and amplified. The analog voltage representing the impedance (resp value) is routed to A/D converter for transfer to the Main Board.

The ECG PWA provides isolated power to its circuitry using an isolation transformer. A transformer driver drives the transformer primary at a frequency of about 350 kHz. The voltage of the transformer secondary is full-wave rectified using two Schottky barrier diodes. The isolated voltage is filtered by capacitors and regulated by a +5V regulator. Isolated ground is obtained from the center tap of the transformer. The data transferred from the A/D converter to the host is isolated using optocouplers.

3.3.5 Keyboard PWA

The Keyboard PWA provides access to the basic functions of the PRO monitor. The buttons that control each function are integrated with its status LED to form a touch pad front panel. LEDs indicate the status of those functions by illuminating green when active and yellow when inactive. The exception is the “SILENCE” button, which is red when active. The function LEDs are driven by latches on the Main Board. The battery LED is continuously yellow when the unit is running on battery and flashes yellow when the battery is charging. The AC LED is green when an external power source is present. The keyboard is connected to the Main Board via a 36 way board-to-board connector.

3.3.6 Pneumatic Control

The pneumatic functional block includes the control signal decode logic, the valve driver circuitry, the pump driver circuitry; pump current measurement circuit, and a safety interlock circuit.

There are two transducers on board, PT1 and PT2. PT1 is used for main readings while PT2 confirms readings and is used to derive overpressure signals. The

following signals are multiplexed into a 16-bit SAR A/D converter via an 8:1 channel DG408:

- PT1A - the output of the measurement pressure sensor after amplification and filtering by means of a passive 1KHz low pass anti-alias filter.
- PT1B - the output of the measurement pressure sensor after amplification and filtering by means of a passive 20Hz low pass anti-alias filter.
- PT2 - the output of the confirmation/over-pressure sensor after amplification.
- TH REF - the voltage that the amplified PT2 has to attain before the safety circuit cuts in
- PT1 REF - the reference voltage that provides an offset voltage for the PT1 amplifier
- PT2 REF - the reference voltage that provides an offset voltage for the PT2 amplifier
- PUMPC - the pump current
- VBAT- 1/11 ratio of VBAT voltage

The 16-bit value out of the ADC is available on the data bus at D[15:0].

Control signals for the board are derived via four different sources: direct control from outputs of the processor, controls signal derived from processor address write commands (which are stored in an addressable latch), signals derived from the watchdog timer, and signals generated by the overpressure functional block. The four valve control signals and the pump control signal are derived from the write address and stored in an addressable latch. Latch values are cleared by application of system RESET generated by the processor. Each latch signal is individually gated in a programmable logic device (16V8) with the fail safe input signal (watchdog timer) and the overpressure latch output to ensure pressure is removed from the patient cuff should either overpressure or processor failure condition occur. A cross-coupled latch for overpressure is included in the programmable logic device. It is set by the occurrence of an overpressure condition existing for a period greater than 500 milliseconds. When this condition occurs, Filter_OVP-0 transitions low setting the internal latch. The latch output state is indicated by the Latched_OVP signal. The latch can only be cleared by the PNEURESET input.

3.3.7 LCD Assembly

The PRO monitor uses TFT (thin film transistor) active matrix color liquid display. The 10.4” diagonal display contains 640 x 480 pixels and can display 262,144 colors simultaneously. The display is backlit by cold-cathode fluorescent lamps.

Note: the backlight power inverter is mounted separately from the other PCB’s.

The LCD is driven from the Primary Processor via buffers (HCT244) on a dedicated LCD driver port:

Signal	Name
Clk	Clock
Vsync	Vertical Sync
Hsync	Horizontal Sync
R[0:3]	Red bits (0:3)
G[0:3]	Green bits (0:3)
B[0:3]	Blue bits (0:3)

The display module has a 31-way control signal connector and a 4-way backlight driving connector.

3.3.8 Printer (Optional)

The PRO monitor uses a thermal graphics printer. The printer requires a 5V supply for its logic circuitry and 12V (nominal) for the motor. The power and data lines are connected to the Main Board by a 40-way cable. The data lines are connected to the SCC3 port on the Primary Processor.

The printer has a built-in sensor to monitor the printer paper level. When the printer is out of paper, it sends a PAPER OUT signal to the Secondary Processor.

SECTION 4. GENERAL MAINTENANCE

Contents

4.1. Introduction 4-3
4.2. Configuring the PRO 1000 Monitor for the First Time 4-3
4.2.1 Unpacking and Preparation for Installation 4-3
4.2.2 Set the Date and the Clock 4-5
4.2.3 Parameter Level Functional Testing 4-6
4.3. Periodic Maintenance 4-7
4.3.1. As Required 4-7
4.3.1.1 Integrity of Cuffs and Hoses 4-7
4.3.1.2 External DC Supply and Battery 4-7
4.3.1.3 Cleaning of Accessories 4-7
4.3.1.4 Long Term Storage 4-8
4.3.2 Annual Procedures 4-8
4.4. Care of Storage Batteries 4-9
4.4.1. Procedures for First Use 4-9
4.4.2 Battery Charging 4-9
4.5 Safety Resistance Testing 4-12
4.6. Alarm Code Interpretation 4-14
4.6.1. System Failures 4-14
4.6.2. Hardware Errors 4-15
4.6.3. Parameter Failures 4-15
4.6.3.1 ECG/RESP Errors 4-15
4.6.3.2 NIBP Messages 4-15
4.6.3.3 Temperature Messages 4-16
4.6.3.4 SpO2 Messages 4-16
4.7. Service Mode Operation 4-16
4.7.1 SpO2 Tests 4-19
4.7.2 NIBP Tests 4-20
4.7.2.1 Leak Test 4-21
4.7.2.2 NIBP Calibration Check 4-23
4.7.2.3 Pressure Recalibration 4-24
4.7.2.4 Overpressure Test 4-25
4.7.3 ECG Tests 4-27
4.7.4 Temp Tests 4-28
4.7.5 Recorder Tests 4-30
4.7.6 Battery Tests 4-31
4.7.7 Test Failsafe Logic 4-32
4.7.8 Keypad LED Test 4-33
4.7.9 Keypad Key Test 4-33
4.7.10 Sound Test 4-33
4.7.11 Turn off the System 4-33
4.8 Service Mode Exit 4-33
Appendix A - Test Record
Appendix B – Monitor Configuration Log

This page intentionally left blank.

SECTION 4. GENERAL MAINTENANCE

4.1 INTRODUCTION

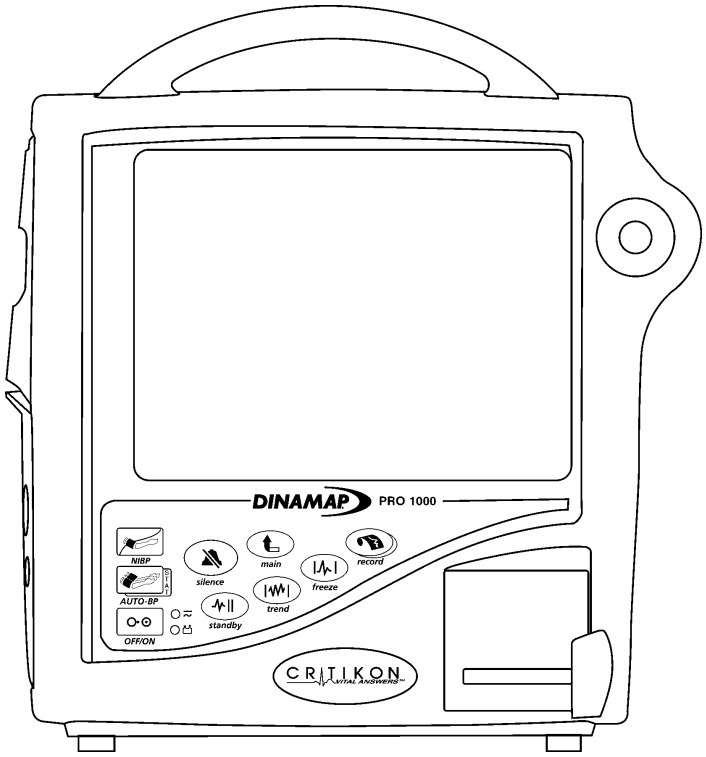
This section contains general Monitor service procedures, including alarm code interpretation, service mode operation, and periodic maintenance and battery care. Refer to Section 5 for disassembly and reassembly procedures and related component service information.

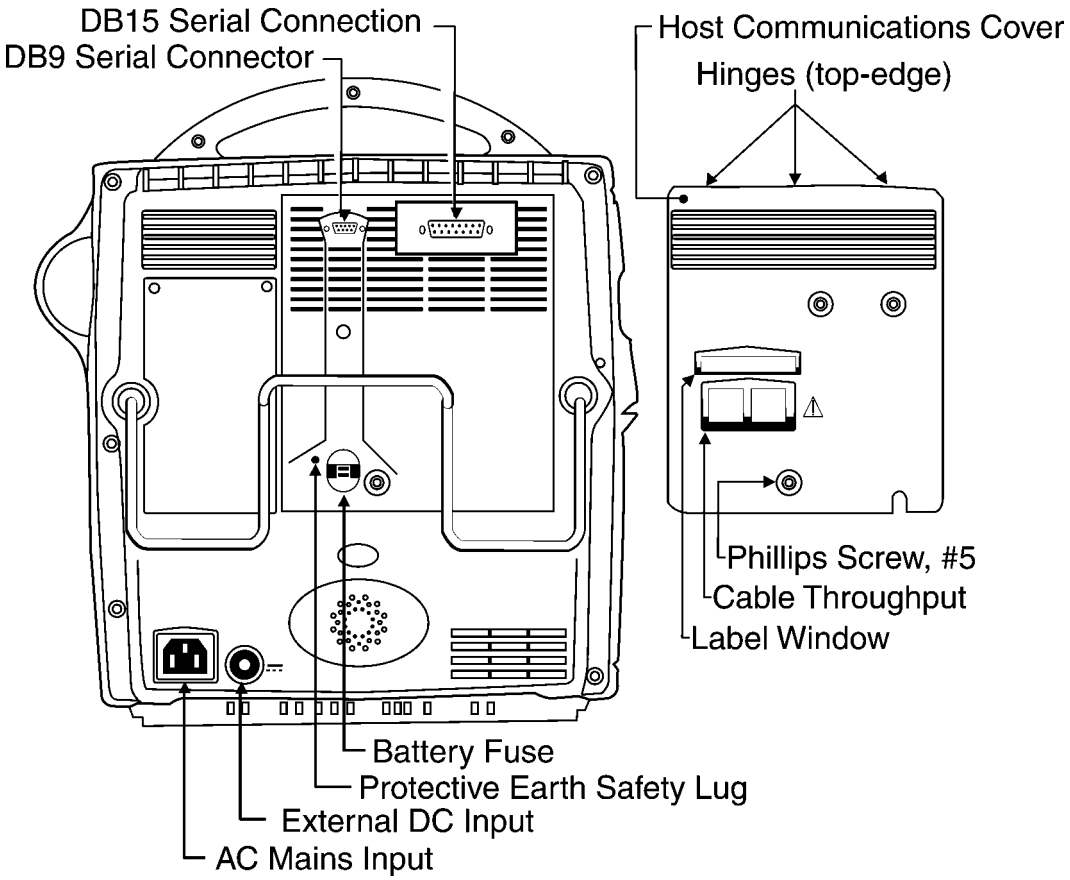
4.2 Configuring the PRO 1000 Monitor for the First Time

4.2.1 Unpacking and Preparation for Installation

1. Unpack and identify the contents of all shipping materials.
2. Remove the PRO 1000 monitor.
3. Unpack the AC cord but do not plug the monitor in at this time.
4. Turn the monitor for access to the Host Comms Cover.
5. Use a Phillips-head screwdriver to remove the single screw that secures the Host Comms cover.
6. The Battery fuse and the Fuse Holder are not connected at time of shipment. Locate and remove the fuse and fuse holder from the protective plastic bag.
7. Identify the Battery Fuse holder located within the Host Comms well, near the lower left side.
8. Insert the Battery Fuse into the Battery Fuse holder
9. Press the Battery Fuse Holder into the Battery Fuse mount using thumb pressure until it is securely snapped in place.
10. Replace the Host Comms cover; refasten the Phillips screw. Tighten using hand-tools only.
11. Plug the AC cord into the AC Mains input at the back of the monitor.
12. Plug the AC cord into a Hospital Grounded AC receptacle. A green LED will illuminate on the front of the monitor indicating that an AC source is available.

Prior to usage it is necessary to charge the monitor for 12 hours. This charge calibrates the battery charging circuitry with the charge status of the battery.

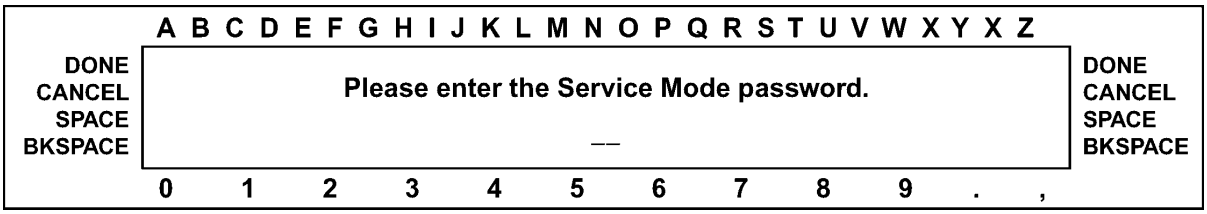

DINAMAP
PRO 1000
NIBP
AUTO-BP
OFF/ON
silence
standby
main
trend
freeze
record
CRITIKON


DB15 Serial Connection
DB9 Serial Connector
Host Communications Cover
Hinges (top-edge)
Phillips Screw, #5
Cable Throughput
Label Window
Battery Fuse
Protective Earth Safety Lug
External DC Input
AC Mains Input

4.2.2 Set the Date and the Clock

The DINAMAP® PRO 1000 monitor uses a rotor knob to navigate through the menu systems. Rotating the rotor moves the arrow cursor, and pressing the rotor makes the selection.

1. Power on the PRO monitor using the **OFF/ON** key
2. Choose ***no*** when the monitor prompts to admit a new patient
3. Press or turn the rotor to access the main menu.
4. Turn the rotor and press to select **other system settings** option.
5. Turn the rotor and press to select **go to config mode** option.
6. Turn the rotor and press ***yes*** to continue to Configuration Mode.
7. The PRO Monitor will now prompt for the Configuration Mode password.


A B C D E F G H I J K L M N O P Q R S T U V W X Y X Z
DONE
CANCEL
SPACE
BKSPACE
Please enter the Service Mode password.
––
DONE
CANCEL
SPACE
BKSPACE
0 1 2 3 4 5 6 7 8 9 . ,

8. Turn the rotor and press to select after each numeral of the password is selected.
9. The password to enter the configuration mode is ***2-5-0-8***.
10. Following the password entry, turn the rotor and press to select **done**.
11. In the process of entering the Configuration Mode, the PRO 1000 monitor will reset. Successful entry into the Configuration Mode can be noted by the words **CONFIGURATION MODE** in red capital letters at the top-center of the screen.
12. Turn the rotor and press to select **other system settings**.
13. Turn the rotor and press to select **config settings…**

The Options available within this menu are:

- Select Date Format – Press the rotor to choose the order Month, Day, and Year appears
- Select Time Format – Press the rotor to choose either a 12-hour clock or a 24-hour clock.
- Adjust Date & Time – Press the Select Knob to enter the correct Date and Time. After setting the date and the time, make sure to press **set new time and date** to save.
- Language – Press the rotor to choose a different language.
- Display Units – Choose ***yes*** to display all units of measure.
- Display Limits – Choose ***yes*** to display all alarm units.
- Reset all to Factory – CAUTION: resets all user-set options to the factory defaults. Yes enables.
- Send all defaults – Choose this option sends all defaults to another connected PRO 1000 monitor through the Host Communications ports.

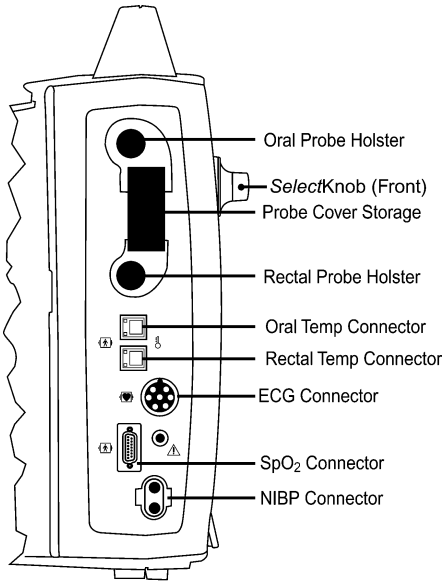
4.2.3 Parameter Level Functional Testing

After the initial configuration is complete, perform functional testing of each of the parameters. Using the accessories supplied with the PRO Monitor, initialize the monitor in such a way that only one parameter is functioning at a time.

- Perform a blood pressure by connecting the supplied hose and cuff together, then attaching to the left side of the PRO Monitor. Press the Start Key on the front to begin the NIBP cycle.

- Connect the supplied temperature probes to the corresponding connections (see right). A predictive temperature will begin once one probe is removed from its' holster. Replace the probe after completion of the Temp cycle.

- The SpO_2 sensor is an assembly consisting of two parts: the DS-100A, and the extender cable SCP-10. Connect the cables prior to attaching to the monitor. A SpO_2 reading will be displayed within moments of attaching the sensor to either a Nellcor simulator or to your finger.



Left Side View of the Monitor
Showing Patient Connections

- Connect the ECG lead connector to the ECG trunk cable prior to connecting to the monitor. The simplest way to function test the ECG circuits is through the usage of an ECG simulator.

  1. Set your simulator to normal heart rate.
  2. Set ECG amplitude to 1.5mV, BPM to 80.
  3. Set respirations to 20 RPM, delta ohms to 1.0.
  4. Verify that the ECG waveform is displayed.
  5. Remove and reattach leads I, II, and III sequentially, and verify that **LEAD OFF** is displayed.
  6. From the ECG menu, select **turn parameter off**.

4.3 PERIODIC MAINTENANCE

4.3.1 As Required

Perform the following maintenance procedures as required.

4.3.1.1 Integrity of Hoses and Cuffs

When the pneumatic integrity of any NIBP cuff and hose is in doubt, replace the cuff and hose, and discard the questionable accessories.

4.3.1.2 Cleaning of Monitor

CAUTION: Do not clean Monitor with isopropyl alcohol or other solvents.

Wipe the exterior of the Monitor with a cloth slightly dampened with mild detergent or normal hospital bactericides. Use dishwashing detergents such as IVORY and JOY (registered trademarks of Procter & Gamble Corp.), or PALMOLIVE (registered trademark of Colgate-Palmolive Corp.)

Do not immerse unit.

4.3.1.3 Cleaning of Accessories

Clean the adult cuffs supplied for use with the monitor by hand washing in warm, soapy water. However, take care to avoid entry of water into the cuff and hoses at any time. If water enters the cuff, dry the cuff by passing air through it.

The neonatal cuffs are for single patient use - discard if they become soiled.

Clean cuffs and hoses with a cloth slightly dampened with mild detergent.

Do not immerse hoses.

Do not immerse cuffs without prior application of cuff hose caps.

Clean SpO2 sensor surface before and after each patient use. Clean SpO2 sensor with a cloth slightly dampened with a mild detergent. Wipe SpO2 sensor to ensure all detergent residue has been removed.

Follow manufacturer's instructions for cleaning ECG lead wires and cable. Compatible cleaning and disinfecting solutions are:

Dishwashing detergents such as IVORY and JOY (registered trademarks of Procter & Gamble Corp.), or PALMOLIVE (registered trademark of Colgate-Palmolive Corp.)

Chlorine bleach disinfectant, 5.25%, 0.75 cup per gallon of water

CAUTION: Do not apply isopropyl alcohol to the Monitor - some parts can become marred and cracked.

Isopropyl alcohol (for accessories only)

Cidex Formula 7 (registered trademark of Johnson & Johnson Medical Products, Inc.) or pHisoHex (registered trademark of Winthrop-Breon Laboratories)

Quaternary-based germicidal detergents like VESTAL INSURANCE (registered trademark of the Vestal Corp.), HI-TOR PLUS (registered trademark of the Huntington Corp.), or VIREX (registered trademark of S.C. Johnson & Son Corp.)

For the above, follow manufacturers' recommendations for dilution rate and use. These recommendations are not an endorsement of the manufacturers or of the effectiveness of these materials for cleaning or disinfecting.

4.3.1.4 Long-Term Storage

If it becomes necessary to store the Monitor for an extended period of time, remove all attached accessories. Attach the original packing inserts, and place the monitor into the original shipping container.

Generally, long-term storage of a nickel-metal hydride battery in either a charged or discharged condition has no permanent effect on capacity. Capacity loss due to self-discharge is reversible, and nickel-metal hydride batteries can recover to full capacity by proper recharging. For example, cycling through repeated charge/discharge cycles can restore a full capacity of a nickel-metal hydride battery that was stored at room temperature for up to one year.

Long-term storage at high temperatures can lead to deterioration of seals and separators and should be avoided.

4.3.2 Annual Procedures

Perform the test procedures described in paragraph **4.7** every twelve months, or whenever the accuracy of any reading is in doubt.

Note: An internal, 3.6V NiMh battery acts as an alarm backup and maintains the nonvolatile RAM memory when the Monitor is off or away from AC mains. A system alarm message will be generated if backup battery replacement is required.

4.4 CARE OF STORAGE BATTERIES

The Monitor uses one nickel-metal-hydride (NiMH) storage battery. The battery can be charged at any time without reducing the charging capacity.

4.4.1 Procedures For First Use

Follow these procedures to condition a new NiMH battery and optimize its performance:

The internal battery will automatically charge when the AC power supply is in use. When the battery is charged for the first time, the charger may indicate prematurely that charging is incomplete. This is normal and can happen with all rechargeable batteries when first charged.

4.4.2 Battery Charging

The Monitor charges the NiMH battery whenever the AC power supply is in use. The Monitor automatically senses if the battery needs recharging. Battery charging will continue as long as the Monitor is connected to the AC power supply, even when the Monitor is turned off.

- Batteries should be charged before first use or after prolonged periods of storage.
- The battery should be charged before use, as a charged battery loses some charge when left in storage.
- The battery should be charged at room temperature (59° F - 86° F; 16° C - 30° C).
- It is normal for the battery to become warm during charging or after use.
- Batteries can be charged or topped-off at any time. It is not necessary to wait until they are fully discharged.
- If the monitor is idle for extended periods, it should be fully charged once a month to ensure optimum performance.

Table 4-1. Battery Alarms

Alarm Type	Indication	Probable Cause
BATT WRONG TYPE - REMOVE or INTERNAL BATT - WRONG TYPE -REMOVE	Message appears in alarm message field	Unapproved battery engaged
BATT CHECKING or INTERNAL BATT - CHECKING	Message appears in alarm message field	Noncommunicating battery engaged
INTERNAL BATT FAIL - REPLACE NOW	Message appears in alarm message field	Internal battery loses voltage or communication or is not accepting proper charge
< 00:30 BATTERY	Message appears in alarm message field and in SelectBox	30 minutes remaining in battery life
< 00:10 BATTERY	Message appears in alarm message field	10 minutes remaining in battery life
SHUTTING DOWN	Message appears in alarm message field	< 1 minute remaining in battery life. Monitor may shut down anytime after 45-60 seconds
AC FAIL - < 00:30 BATTERY	Message appears in alarm message field and procedural alarm sounds	Upon loss of AC power, the internal battery is engaged with less than 30 minutes of life (but more than 10 minutes) remaining
CHECK COOLING FAN	Message appears in the alarm message field	Monitor's internal temperature is too high. Cooling fan may be blocked or inoperative
AC FAIL - < 00:10 BATTERY	Message appears in alarm message field and crisis alarm sounds	Upon loss of AC power, the internal battery is engaged with less than 10 minutes of life remaining

Table 4-2. Battery Troubleshooting

Trouble	Probable Cause	Remedy
Battery inoperative or does not last very long.	Battery not fully charged.	Charge and discharge battery up to three times for optimum performance.
	Battery in long-term storage or nonuse.	Remove and reinstall battery so connector is properly seated.
Battery charged for only a short period of time before indicating full charge.	Improper procedure for charging battery for first time use.	When charging battery for first time, charger may indicate prematurely that charging is completed. Discharge battery and repeat charging procedure.
Battery will not charge.	Charging battery in unusually cold or hot temperatures.	Charge at basic room temperature of 59° F (16° C) to 86° F (30° C). Slowly bring battery to basic room temperature before recharging. Batteries cannot be fully charged unless internal temperatures between 57° F (15° C) and 109° F (40° C).

4.5 SAFETY RESISTANCE TESTING

Using a safety analyzer (Dynatech Nevada Model 235A or equivalent), check the ground resistance of the PRO 1000 Monitor; refer to the Rear View graphic for locations of test points.

Earth-To-Secondary Continuity
Verify that the resistance between the AC Mains ground pole and the External DC connector ground is less than or equal to 1Ω.

AC Mains Leakage – Normal Polarity
For the following tests, 260 VAC is applied at the Monitor's AC Mains input in normal polarity.

No Fault
Verify that the leakage from the Line pole to the Ground pole is less than or equal to 500 μA.

Open Ground
Disconnect the Monitor's ground lead from earth ground (for the duration of this test only) and verify that the leakage from the Line pole to the Ground pole is less than or equal to 500 μA.

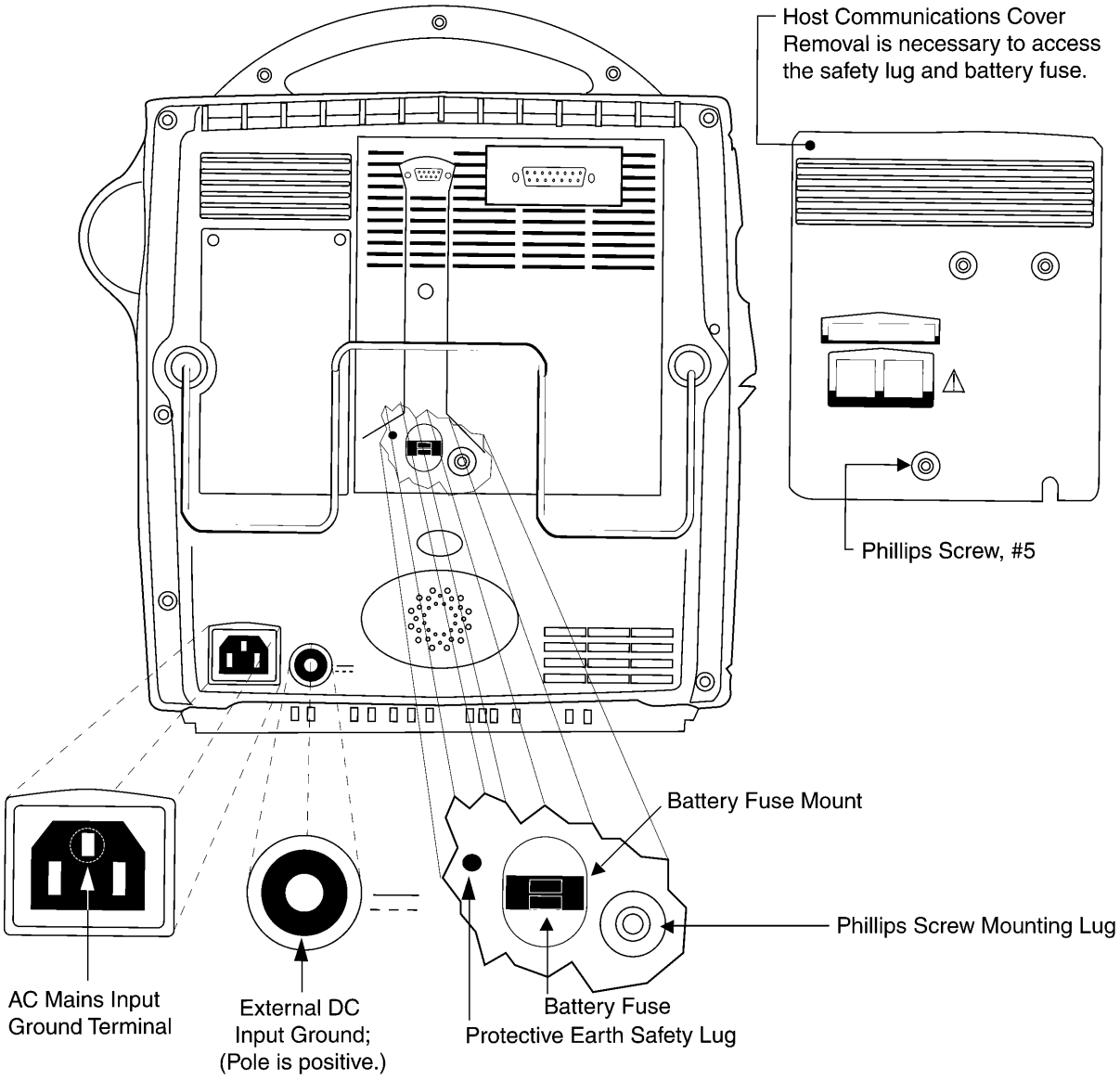
Open Neutral
Open the Monitor's neutral lead (for this test only) and verify that the leakage from the Line pole to the Neutral pole is less than or equal to 500 μA.

AC Mains Leakage – Reverse Polarity
For the following tests, 260 VAC is applied at the Monitor's AC Mains input in reverse polarity (inputs to Line pole and Neutral pole reversed).

No Fault
Verify that the leakage from the Line pole to the Ground pole is less than or equal to 500 μA.

Open Ground
Disconnect the Monitor's ground lead from earth ground (for the duration of this test only) and verify that the leakage from the Line pole to the Ground pole is less than or equal to 500 μA.

Open Neutral
Open the Monitor's Neutral lead (for the duration of this test only) and verify that the leakage from the Line pole to the Neutral pole is less than or equal to 500 μA.



Rear View of Monitor with safety connection exposed

4.6 ALARM CODE INTERPRETATION

Refer to Table 4-1 for information about procedural alarms that involve battery operation. If any other alarms appear that are not listed in the paragraphs that follow, record the error message and report the failure to Customer Support. Refer to the Operation Manual for information about patient alarms and general procedural alarms.

4.6.1 System Failures

When a system failure is encountered, the error code is displayed on the screen for five seconds and the system enters failsafe mode. The error code is logged in the history log.

General system error codes are listed below. If any other **SY** or similar code appears, report it to Customer Support.

Error Code	Explanation	Possible Cause(s)
SY-16	Power fail signal true time is too long	Circuit that drives POWERFAIL* signal is defective
SY-19	Software detected power supply out of limits	1. Go to service mode to observe current values for power supplies 2. Digital to analog converter is defective
SY-20	Checksum of code in flash memory is not valid	1. Defective flash memory chip. 2. Error during programming of flash memory.
SY-43	Real time clock running too slow	1. RTC chip running too slow or not at all. 2. System clock running too fast.
SY-44	Real time clock funning too fast	1. Noise getting into RTC chip crystal input. 2. Defective or wrong crystal on clock chip. 3. System clock running too slow.

4.6.2 Hardware Errors

These error codes, which are common to all parameters, indicate some internal self-check test of the hardware has failed, and service is required.

Error Code	Description
8193	HW, Time base failure
8202	HW, Power supply, System
8222	HW, RAM test failure
8232	HW, ROM checksum failure
8242	HW, Isolation interface comm failure
8252	HW, Secondary processor not compatible

4.6.3 Parameter Failures

4.6.3.1 ECG/ TEMP Errors

Fail Code	Description
101	ECG board data rate error.
201	ECG board cmd queue overrun

4.6.3.2 NIBP Messages

Fail Code	Description
110	Overpressure circuit failure
112	Overpressure watchdog error
120	FPT test failure
130	EEProm read failure
131	EEProm write failure
140	Transducer initialization failure
141	Calibration of a transducer channel's zero failed
142	Calibration of a transducer channel's span failed
150	Auto zero failure
151	Auto Zero. Verify failed.
160	PT1 reference failure
161	PT2 reference failure
162	OVC reference failure
170	Pump current failure
171	Pump current value out of range
180	Excessive leakage

Fail Code	Description
190	Commands out of sequence
200	OVP setpoint not found
210	Pump stuck on during idle
220	Valve in illegal state
221	Pressure too high for too long

4.6.3.3 Temperature Messages

Fail Code	Description
114	Temp data line out of sync with clock
115	Temp date frames out of sync

4.6.3.4 SpO2 Messages

In operate mode, the Fail Code is reported as described in section 4.6.3. In service mode, the Service Mode Code (hex) is displayed on the screen as a Parameter Fatal Error (hex).

Fail Code	Description
125	Too many reset requests
126	Nellcor has posted a “serious” FE error
127	Nellcor FE requests power cycle
128	Nellcor over-current error
129	FE data OK – processing stalled

4.7 SERVICE MODE OPERATION

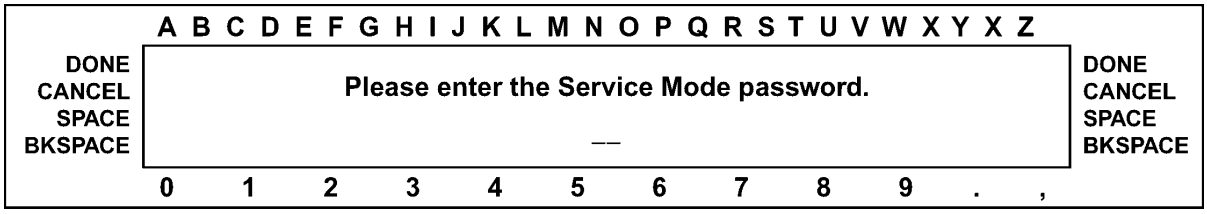
The Monitor service mode exercises the built-in diagnostic features of the Monitor and the installed parameters. Access the service mode from a cold start by proceeding as follows:

1. Momentarily press the on/off button at the front of the Monitor. Observe that a beep sounds and that the power up screen displays.

2. Press the Rotor to answer **no** to the **admit patient** prompt, rotate the *Rotor*, and observe the main menu is displayed on the left side of the screen.

3. Rotate the Rotor to select **other system settings**.

Select **go to service mode**. Rotate and press the knob again to answer **yes** at the prompt. Note that the menu changes to what is shown below.


A B C D E F G H I J K L M N O P Q R S T U V W X Y X Z
DONE
CANCEL
SPACE
BKSPACE
Please enter the Service Mode password.
––
DONE
CANCEL
SPACE
BKSPACE
0 1 2 3 4 5 6 7 8 9 . ,

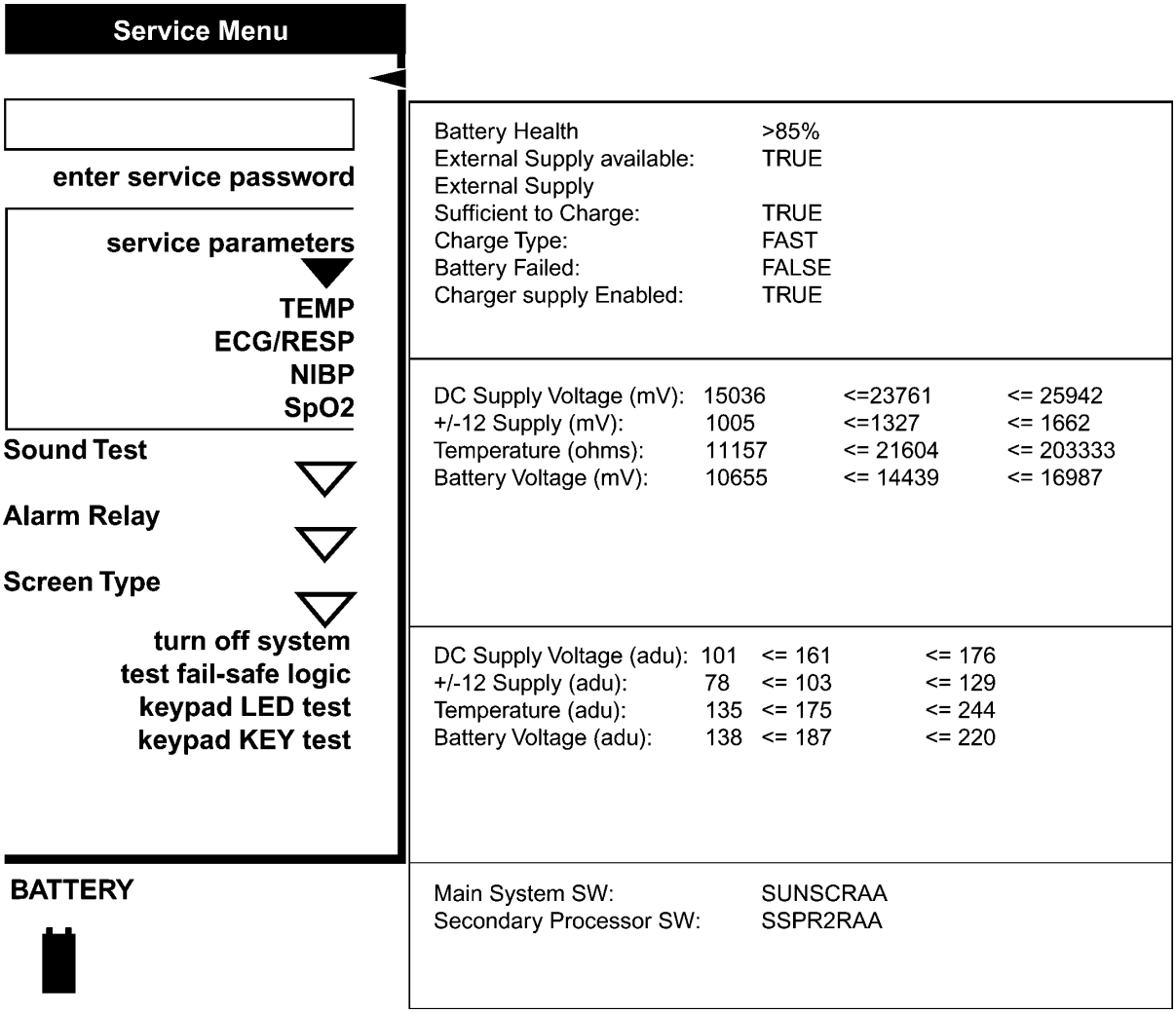
4. Observe that a row of numbers is displayed at the bottom of the screen. Turn the rotor and press to select after each numeral is selected.

5. The password to enter service mode is: **2213.** Following completion of the password entry, turn the rotor and press to select **DONE**.

6. In the process of entering the Service Mode, the PRO 1000 Monitor will reset. Successful Entry into Service Mode can be noted by the Service Menu title display on the upper left side of the display.

NOTE: The service mode can also be entered directly from a cold start by pressing and holding the following three keys until full power-up: OFF/ON, AUTO-BP, ands GO/STOP. To make any changes to the Service Menu, the password will still have to be entered: press the rotor to **enter service password.**

7. At this point the Service Mode main screen should be present in the main display, as shown below. The service menu **service parameters** area displays a list that corresponds to the number and type of parameters that have been detected by the Monitor. If the service mode was entered directly (as described in the NOTE above), **enter service password** appears above the service parameters on the service menu. If recalibration of any component is required, the password MUST be entered (as described in steps 5 and 6) before any changes to calibration can be made.


Service Menu
enter service password
service parameters
TEMP
ECG/RESP
NIBP
SpO2
Sound Test
Alarm Relay
Screen Type
turn off system
test fail-safe logic
keypad LED test
keypad KEY test
BATTERY
Battery Health >85%
External Supply available: TRUE
External Supply Sufficient to Charge: TRUE
Charge Type: FAST
Battery Failed: FALSE
Charger supply Enabled: TRUE
DC Supply Voltage (mV): 15036 <=23761 <= 25942
+/-12 Supply (mV): 1005 <=1327 <= 1662
Temperature (ohms): 11157 <= 21604 <= 203333
Battery Voltage (mV): 10655 <= 14439 <= 16987
DC Supply Voltage (adu): 101 <= 161 <= 176
+/-12 Supply (adu): 78 <= 103 <= 129
Temperature (adu): 135 <= 175 <= 244
Battery Voltage (adu): 138 <= 187 <= 220
Main System SW: SUNSCRAA
Secondary Processor SW: SSPR2RAA

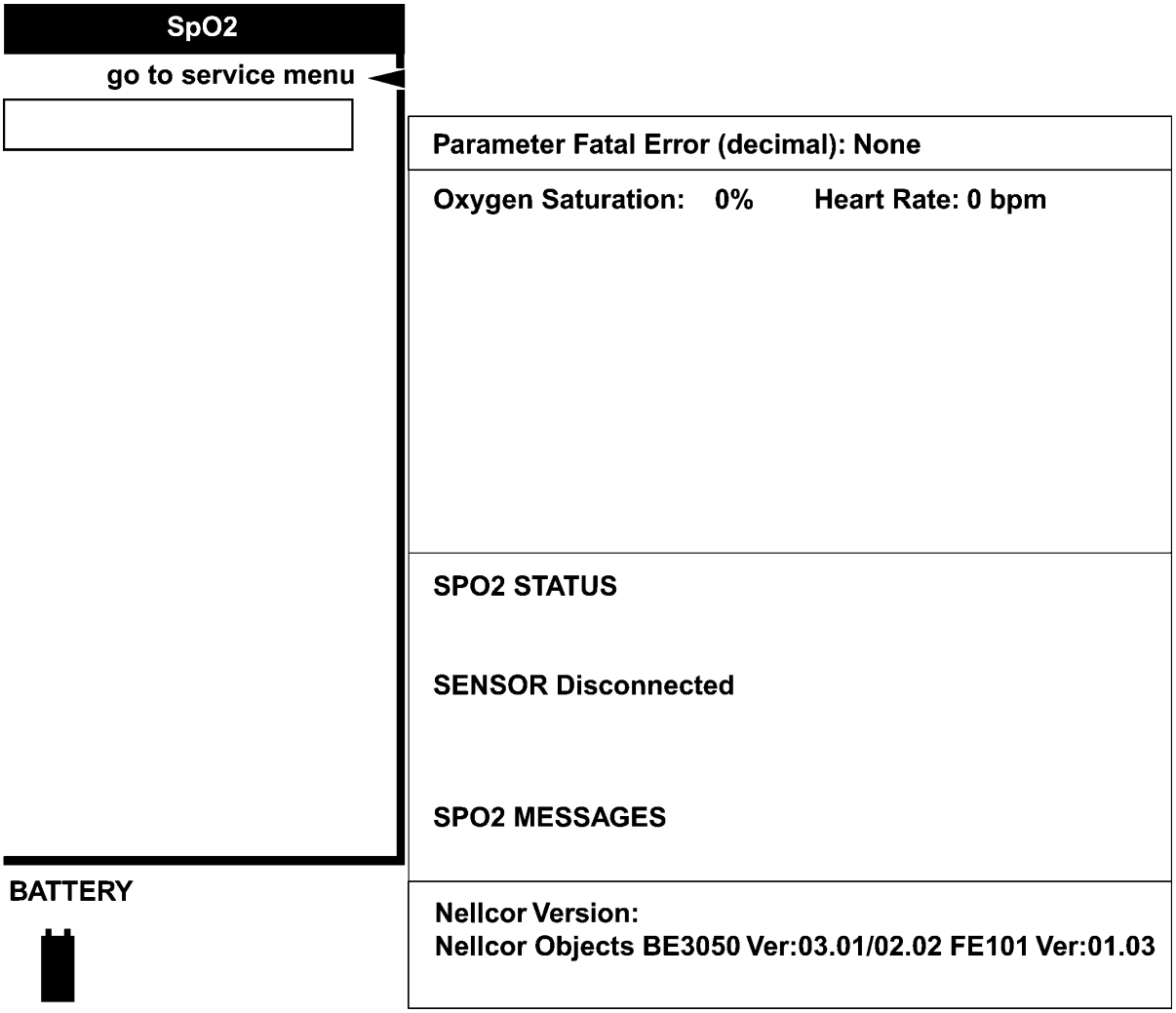
Main Service Menu

For each parameter, there are one or more service screens that display operating values and tests that are applicable to the parameter type. Refer to the following paragraphs for information about each parameter. At the conclusion of the tests, select **go to service menu** at the top of the screen to return to the Service Menu main screen.

4.7.1 SpO2 Tests

1. Disconnect all sensor cables from the SpO2 Parameter, and ensure that the SpO2 parameter is listed within the main Service menu.

2. From the Service Menu, Turn and press the rotor to select the SpO2 service parameter. The SpO2 service menu should appear, with the **SpO2 STATUS** displaying **SENSOR Disconnected** and the SPO2 MESSAGES display empty. Example shown below.



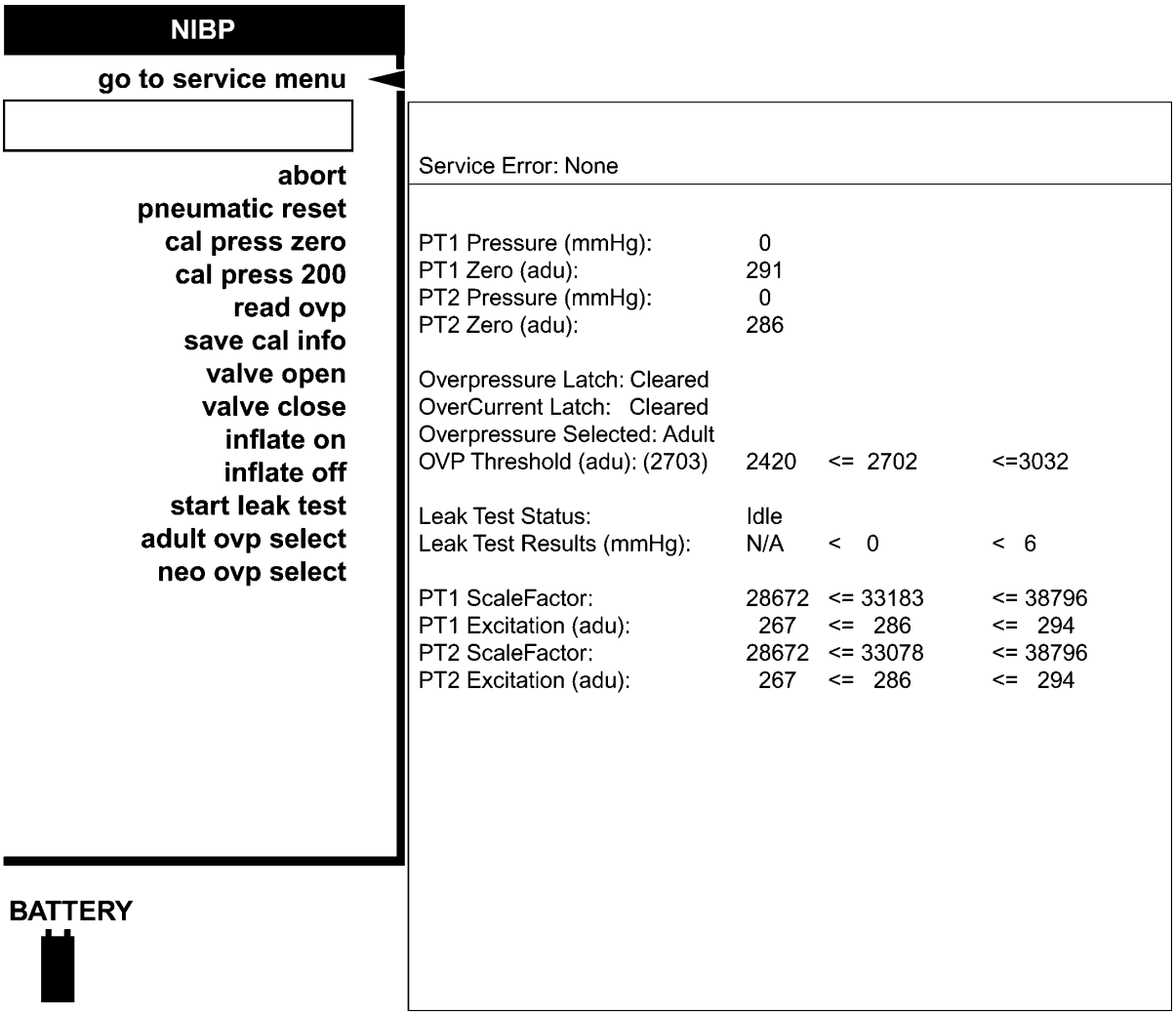
SpO2 Service Menu

3. Insert the Nellcor SRC-2 pocket tester into the Parameter front panel SpO2 sensor socket (use the extender cable SCP-10), and press until fully seated in the socket.

4. After a few seconds, the two red LEDs should light on the pocket tester. The SpO2 service menu should soon display a saturation of 80±1 and also displaying the heart rate as set on the SRC-2 pocket tester. Cycle through the 3 ***RATE*** settings and verify that the monitor responds accordingly.

5. Remove the SRC-2 pocket tester from the extender cable and verify that the monitor reports a **SENSOR Disconnected** message in the **STATUS** box.

4.7.2 NIBP Tests



NIBP Service Menu

Perform the following tests to determine that the NIBP parameter is functioning normally.

4.7.2.1 Leak Test

CAUTION
Calibration equipment should always be kept dry and free of particulate matter. Moisture or foreign substances introduced to the pneumatic system will likely cause damage to the monitor and/or the accessories.

1. Using the calibration kit (part number 320-246), an adult cuff and air hose, and a manometer, set up the equipment as shown in Figure 3-1. Connect the hose to the NIBP Parameter. Make sure all fittings are tight, and that the valve on the manual inflation bulb is fully closed.

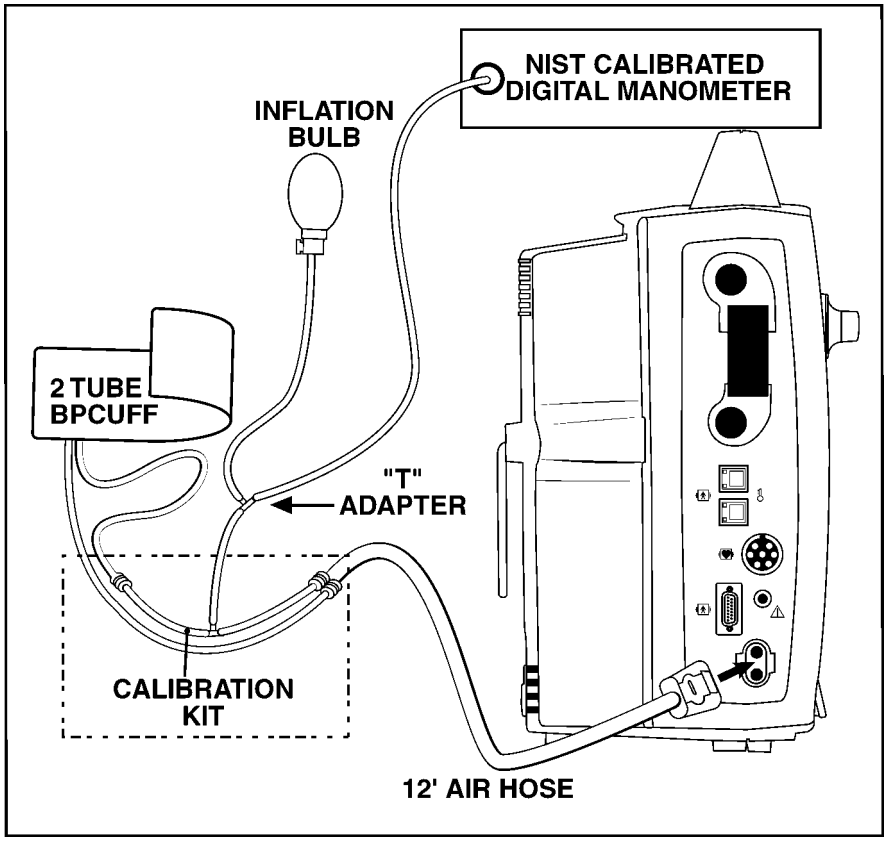


Figure 4-1. NIBP Test Setup

2. From the Service Menu, Turn and press the rotor to select the NIBP service parameter.

3. Turn and press the rotor to select **pneumatic reset**.

4. Turn and press the rotor to select **valve close**.

5. Turn and press the rotor to select **start leak test**. Observe that the **Leak Test Status** message on the menu indicates **Busy**.

6. Observe that the pump begins inflating the system to 200 ~ 210 mmHg, at which point the pump operation will cease. The Monitor will begin to calculate system pressure loss rate.

7. After about 60 seconds, the pressure is released, and the menu should display **Leak Test Status Passed**, and the **Leak Test Results** indication should be a value less than 6. **Service Error: None** should continue to display.

8. If the menu displays **Leak Test Failed**, continue to step 9.

9. Using the calibration kit (part number 320-246), an adult cuff and air hose, and a manometer, set up the equipment as shown in Figure 4-2.

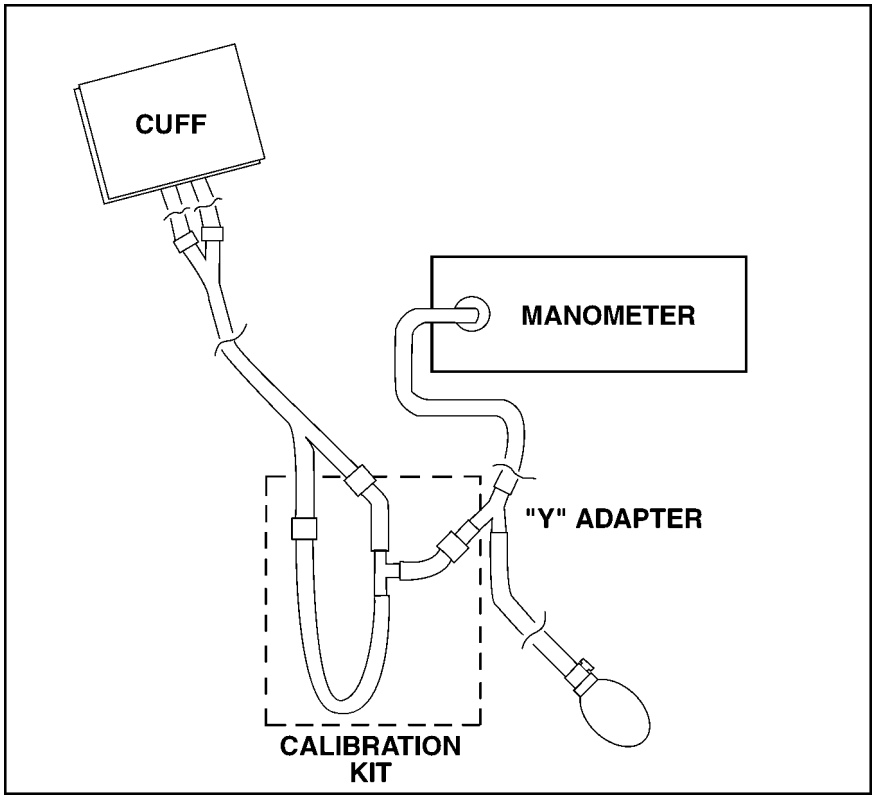


Figure 4-2 Leak Test Setup

10. Close the pressure release valve on the manometer inflation bulb and slowly increase the pressure to 200-mmHg ±1 mmHg.

11. Verify the pressure indicated on the manometer remains within 5 mmHg of 200 mmHg for 60 seconds. If not, either the cuff or hose or both may be defective. If the cuff and hose pass this test, repeat steps 1 through 7 to try to isolate the leak. Repeat the leak test for all cuff and hose combinations to be used with the Monitor.

CAUTION
Calibration equipment should always be kept dry and free of particulate matter. Moisture or foreign substances introduced to the pneumatic system will likely cause damage to the monitor and/or the accessories.

4.7.2.2 NIBP Calibration Check

1. Using the calibration kit (part number 320-246), an adult cuff and air hose, and a manometer, set up the equipment as shown in Figure 4-1. Connect the hose to the NIBP Parameter. Make sure all fittings are tight, and that the inflation bulb valve is closed tightly.

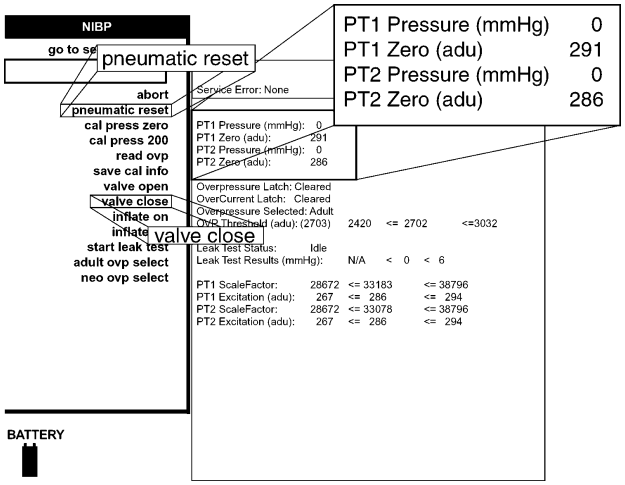
2. From the Service Menu, Turn and press the rotor to select the NIBP service parameter.

3. Turn and press the rotor to select **pneumatic reset**.

4. Turn and press the rotor to select **valve close**.

5. Observe that both **PT1 Pressure** and **PT2 Pressure** equal initial values of zero mmHg **(0 mmHg)**.

6. Connect the pneumatic hose to the Monitor's NIBP port.



7. Fold the adult cuff so the index line is aligned with the inner range mark on the inside of the cuff. Make sure all fittings are tight, and that the valve on the inflation bulb is closed tightly. If there is doubt about the integrity of the system, perform the leak test (paragraph 4.7.2.1) before continuing.

8. Close the pressure release valve on the manometer inflation bulb and manually pump up the pressure until the manometer indicates approximately 220 mmHg.

9. Allow the pressure to stabilize for at least a minute. Then open the pressure release valve on the manometer inflation bulb and carefully bleed off pressure until the manometer indicates 200 mmHg.

10. Observe that the values of **PT1 Pressure** and **PT2 Pressure** on the menu indicate within 1 mmHg of the pressure shown on the manometer.

11. Verify the system linearity by repeating steps 8 & 9 using manometer readings of 250 mmHg, 150 mmHg, and 50 mmHg. Observe that the **PT1** and **PT2 Pressures** are within 3 mmHg of manometer readings for each of these pressure indications.

4.7.2.3 Pressure Recalibration

CAUTION
Calibration equipment should always be kept dry and free of particulate matter. Moisture or foreign substances introduced to the pneumatic system will likely cause damage to the monitor and/or the accessories.

1. Always enter Service Mode with the password, as described in paragraph 4.7, before attempting to recalibrate equipment.

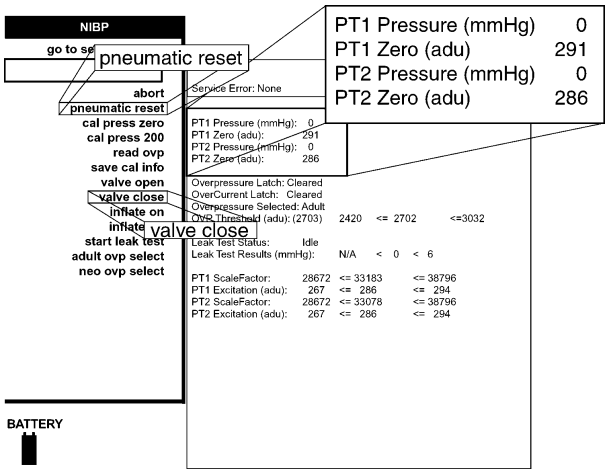
2. Using the calibration kit (part number 320-246), an adult cuff and air hose, and a manometer, set up the equipment as shown in Figure 4-2. Do not connect the pneumatic hose to the NIBP port yet.

3. From the Service Menu, Turn and press the rotor to select the NIBP service parameter.

4. Turn and press the rotor to select **pneumatic reset**.

5. Turn and press the rotor to select **valve close**.

7. Observe that both **PT1 Pressure** and **PT2 Pressure** display initial values of **0** on the menu.



8. Turn and press the rotor to select **cal press zero**. Observe that the message **Inflate System to 200 mmHg Then Hit 'Cal Press 200'** is displayed on menu.

9. Connect hose to NIBP Parameter.

10. Fold the adult cuff so the index line is aligned with the inner range mark on the inside of the cuff. Make sure all fittings are tight, and that valve on inflation bulb is closed tightly. If there is doubt about the integrity of the system, perform the leak test (paragraph 4.7.2.1) before continuing.

11. Close the pressure release valve on the manometer inflation bulb and manually pump up the pressure until the manometer indicates approximately 220 mmHg.

12. Allow the pressure to stabilize for at least a minute. Then open the pressure release valve on the manometer inflation bulb and carefully bleed off pressure until the manometer indicates a little more than 200 mmHg.

13. Turn and press the rotor to select **cal press 200**, but do not press the knob at first.

14. When the manometer indicates exactly 200 mmHg, press the Rotor. Observe that system pressure is released, and the message: **!!!!! CAL INFO NOT SAVED!!!!!** is displayed on menu.

15. Turn and press the rotor to select **save cal info**. If the system is operating normally, the menu displays **Service Error: None**, and the calibration setting is saved.

16. Repeat the calibration check procedure (paragraph 4.7.2.2) to confirm the calibration setting.

4.7.2.4 Overpressure Tests

CAUTION
Calibration equipment should always be kept dry and free of particulate matter. Moisture or foreign substances introduced to the pneumatic system will likely cause damage to the monitor and/or the accessories.

1. Using the calibration kit (part number 320-246), an adult cuff and air hose, and a manometer, set up the equipment as shown in Figure 4-1. Connect the hose to the NIBP Parameter. Make sure all fittings are tight, and that valve on inflation bulb is closed tightly.

2. From the Service Menu, Turn and press the rotor to select the NIBP service parameter.

3. Turn and press the rotor to select **pneumatic reset**.

4. Turn and press the rotor to select **valve close**.

5. Observe that the menu displays **Overpressure Selected Adult**. If not, turn and press the rotor to select **adult ovp select**.

6. Turn and press the rotor to select **inflate on**. The pump should begin to inflate the system.

7. Watch the pressure indication increase on the manometer, and observe that the pump is shut down and the pressure is released when the manometer indicates in the range of 300 to 330 mmHg. Observe that the menu displays **Service Error: None**.

8. Turn and press the rotor to select **pneumatic reset**.

9. Turn and press the rotor to select **valve close**.

10. Turn and press the rotor to select **neo ovp select**. Observe that the menu displays **Overpressure Selected Neo**.

11. Turn and press the rotor to select **inflate on**. The pump should begin to inflate the system.

12. Watch the pressure indication increase on the manometer, and observe that the pump is shut down and the pressure is released when the manometer indicates in the range of 150 to 165 mmHg. Observe that the menu displays **Service Error: None**.

13. If the overpressure test results in an “out of tolerance” condition, contact Critikon Technical Support at 877-274-8456 for assistance.

4.7.3 ECG Tests

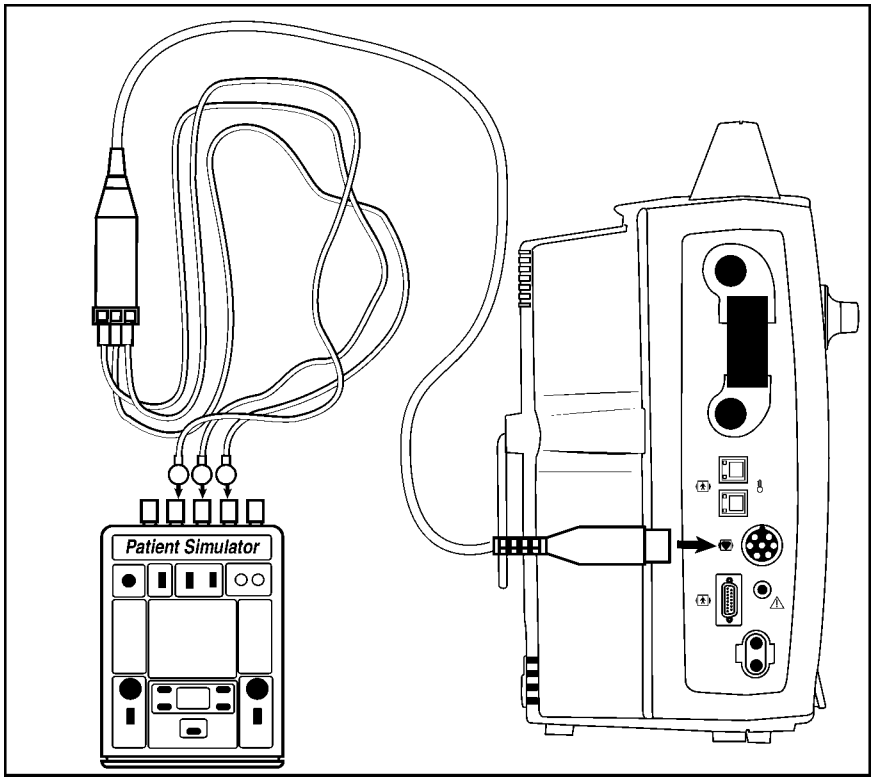
Connect the ECG leads to the ECG trunk cable prior to connection to the monitor. The simplest way to function test the ECG circuitry is through the usage of an ECG simulator with the monitor in normal monitoring mode.

1. Set your simulator to normal heart rate.

2. Set the simulator's ECG amplitude to 1.5 mV, BPM to 80.

3. Set respirations to 20 RPM, delta ohms to 1.0.

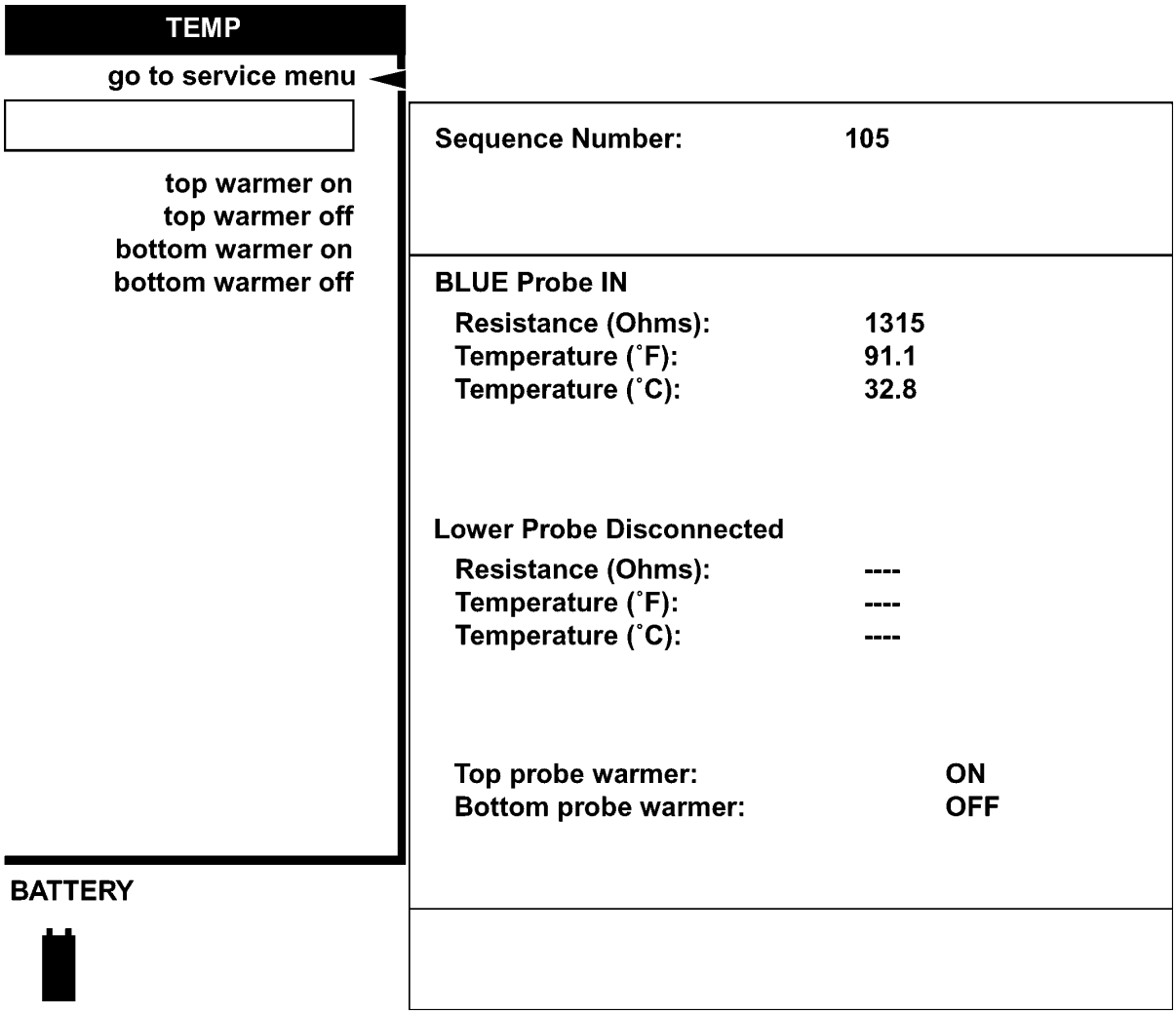
4. Remove and reattach leads I, II, and III sequentially, and verify that LEAD OFF is displayed in the main window.



4.7.4 TEMP Tests

1. Disconnect the all sensor cables from the Alaris temperature connections.

2. From the Service Menu, Turn and press the rotor to select the TEMP service parameter. The TEMP service menu should appear as shown below.

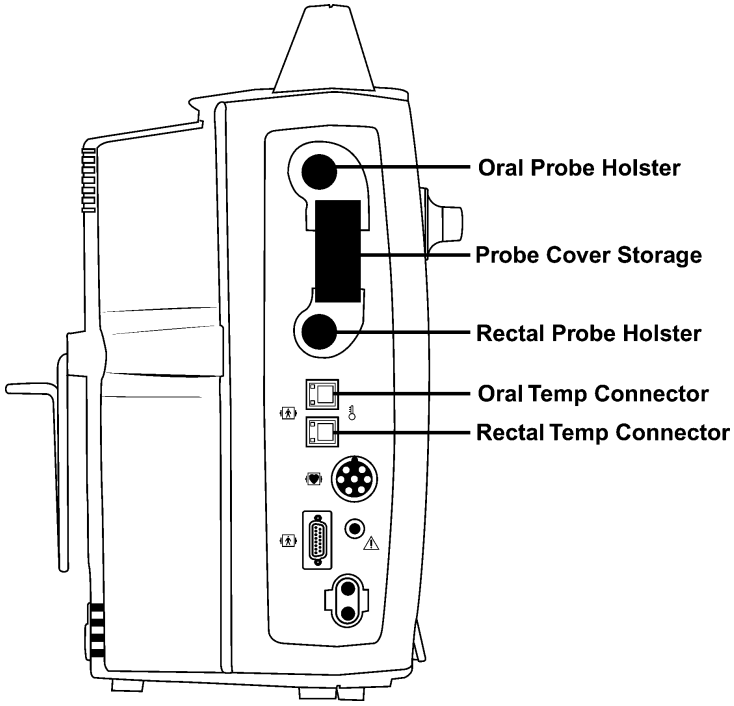


Temperature Service Menu

3. Connect both the Oral and Rectal Temp probes to their respective connections, reference the graphic below.

4. Perform the following test to verify the integrity of the temperature parameter:

    - Verify top probe IN/OUT
    - Verify top probe warmer ON. Observe that the temperature reading rises to 105.0º F.
    - Verify top probe warmer OFF. Observe that the temperature reading drops slowly.
    - Verify bottom probe IN/OUT
    - Verify bottom probe warmer ON. Observe that the temperature reading rises to 105.0º F
    - Verify bottom probe warmer OFF. Observe the temperature reading drops slowly.



4.7.5 RECORDER tests (if fitted)

1. Ensure that paper has been loaded into the Recorder Parameter, and you are presently in the Service Mode.

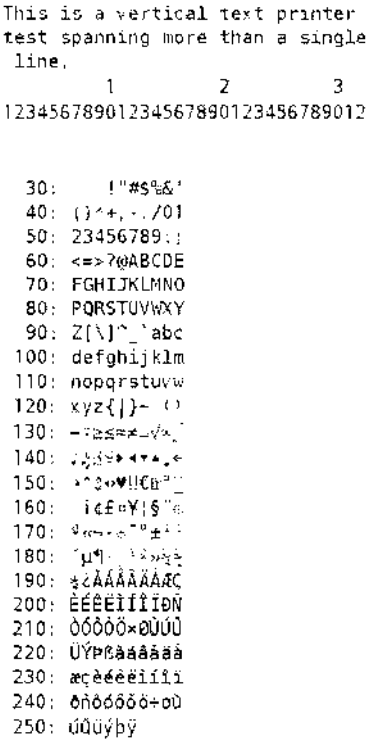
2. From the Service Menu, Turn and press the rotor to select the RECORDER test option. Turn and press the rotor to choose the 3 waveforms option. Verify that all printouts are of even tone and all pixels are present.

3. Select the 6.25mm/S option.

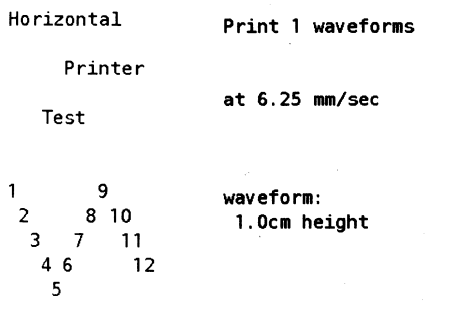
4. Allow for the paper to spool out a 12 inch printed section.

5. Select Vertical Text test. Verify that the printed text is legible and evenly spaced.

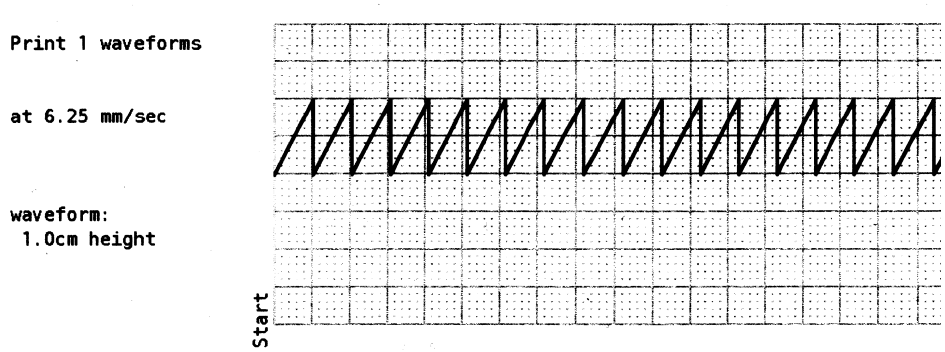
6. Select Horizontal Text test. Verify that the printed text is legible and evenly spaced.



Vertical Text printout



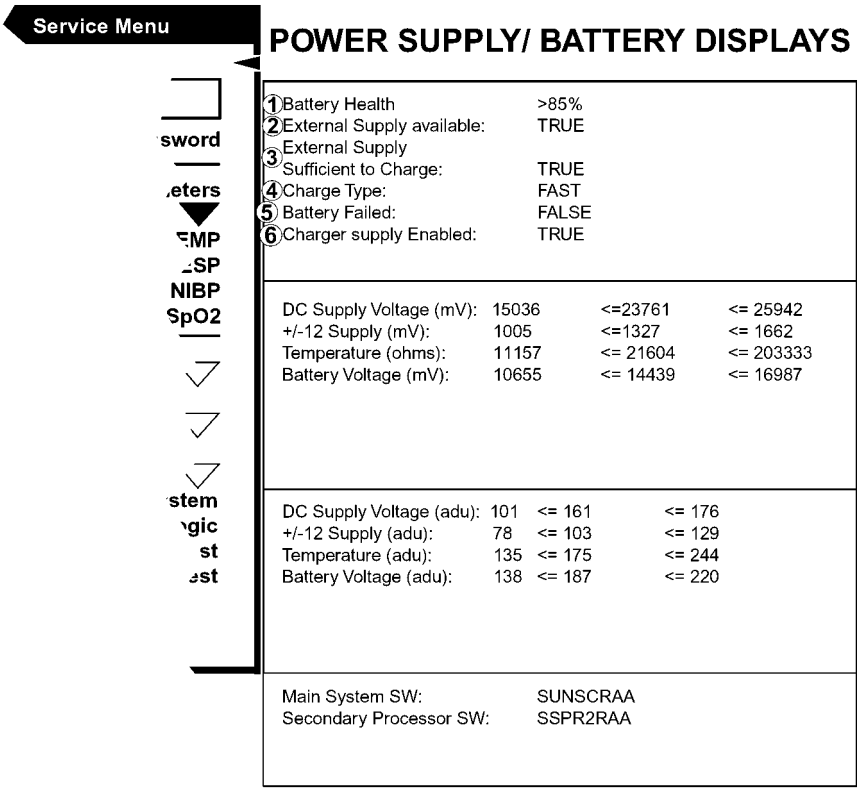
Horizontal Text print test



Sample 6.25 mm/sec – 1 waveform chosen

4.7.6 Battery Tests

From within the Service Menu, battery status information is displayed on the right upper 1/4th of the display.


Service Menu
POWER SUPPLY/ BATTERY DISPLAYS
sword
eters
MP
SP
NIBP
SpO2
stem
gic
st
st
1 Battery Health >85%
2 External Supply available: TRUE
3 External Supply Sufficient to Charge: TRUE
4 Charge Type: FAST
5 Battery Failed: FALSE
6 Charger supply Enabled: TRUE
DC Supply Voltage (mV): 15036 <=23761 <= 25942
+/-12 Supply (mV): 1005 <=1327 <= 1662
Temperature (ohms): 11157 <= 21604 <= 203333
Battery Voltage (mV): 10655 <= 14439 <= 16987
DC Supply Voltage (adu): 101 <= 161 <= 176
+/-12 Supply (adu): 78 <= 103 <= 129
Temperature (adu): 135 <= 175 <= 244
Battery Voltage (adu): 138 <= 187 <= 220
Main System SW: SUNSCRAA
Secondary Processor SW: SSPR2RAA

Battery/ Power Supply menu

1. Battery Health: the Monitor's software approximates the true status of the battery's health. The value indicated is displayed as both a number (in percentage) and as an icon on the bottom-left area of the display.

2. External Supply available: True indicates a source other than the internal battery is providing power for the monitor, and a source to charge the internal battery.

3. External Supply Sufficient to Charge: If the voltage from the external supply is greater than that of the internal battery, the monitor will display the results as TRUE. False will result if either the voltage is equal to or lower than the power available from the internal battery.

4. Charge Type: Fast or Slow.

5. Battery Failed: Any result other than FALSE, indicates that the internal battery has suffered a failure and should be investigated.

6. Charger Supply Enabled: Should always be TRUE as the monitor consistently attempts to keep the battery at its' fullest capacity. A FALSE indicates the battery may be faulty or not installed, or the charge circuit may have failed. Also, if no external source of power is available, the monitor will register a FALSE result.

4.7.7 Test Failsafe Logic

1. From the Service Menu, turn the rotor to select **test fail-safe logic**. A dialogue box will appear:
2.

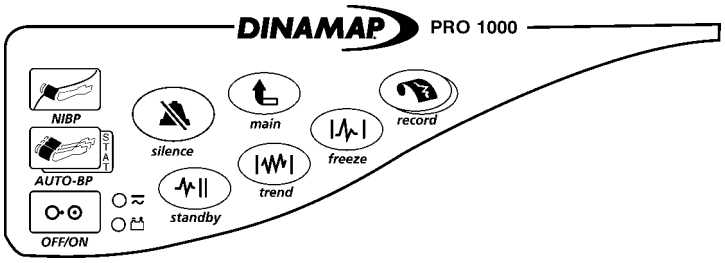
   CAUTION! This will cause the system to freeze for approx.
   2 seconds then enter fail-safe mode. Continue?

   Answer **yes**.

2. After two seconds, the system will freeze and an alarm will sound. Recycle the system power using the on/off button. To return to the Service Mode, repeat the procedures as described in section **4.7.**

4.7.8 Keypad LED Test

1. From the Service Menu, rotate and press the rotor to select **keypad LED test**. Observe that each of the keys on the PRO 1000 monitor-face, illuminate one key at a time. With the exception of the ON/OFF key, observe whether any of the keys fail to illuminate.



2. After all keys have been tested, press the rotor again to stop the test.

4.7.9 Keypad KEY Test

Verify that the keypad LEDs are illuminated (except Main, Trend, and Standby)

4.7.10 Sound Test

Verify that the Monitor produces tones of various pitches when this option is selected.

4.7.11 Turn off system

Selection of this menu item will bring up a dialogue window requesting you to confirm your decision:

CAUTION! This will turn the system off. Are you sure you want to do this?

Selecting **yes** will power off the monitor; **no** will return you to the Service Menu.

4.8 SERVICE MODE EXIT

To exit the service mode and power off the Monitor, locate and press the key marked **ON/OFF** at the front of the Monitor.

This page intentionally left blank.

TEST RECORD (Appendix A)

Model#_____Serial#_____.

Step	Description	Min	Max	Actual	Pass	Fail	N/A
	SpO_2 Tests						
4.7.1	Verify Pleth waveform						
4.7.1	SpO_2 reading at 100% Saturation	96	100				
4.7.1	SpO_2 reading at 90% Saturation	86	94				
	Internal Tests (Perform in Service Mode)						
4.7.2.1	Leakage Test						
4.7.2.2	UUT Pressure - 50 mmHg	46	54				
4.7.2.2	UUT Pressure - 150 mmHg	145	155				
4.7.2.2	UUT Pressure - 250 mmHg	244	255				
4.7.2.4	Verify adult overpressure occurs between 300~350 mmHg						
4.7.2.4	Verify neo overpressure occurs between 150~165 mmHg						
4.7.4	Verify top probe IN/OUT						
4.7.4	Verify top probe warmer ON						
4.7.4	Verify top probe warmer OFF						
4.7.4	Verify bottom probe IN/OUT						
4.7.4	Verify bottom probe warmer ON						
4.7.4	Verify bottom probe warmer OFF						
4.7.5	Recorder Test						
4.7.8	Keypad Test						
4.7.10	Speaker Test						
	ECG Tests (Perform in Monitor Mode)						
4.7.3	Verify Waveform						
4.7.3	Verify BPM (@ 80 BPM)	76	84				
4.7.3	Verify Paced Signal						
4.7.3	Verify Lead-Off						
	RESP Tests (Perform in Monitor Mode)						
	Verify Waveform						
	Verify RESP (@ 20 RPM)	17	23				
	Verify RESP (@ 5 RPM)	2	8				
	Verify alarm sounds & displays below 6 RPM						
	BPM Tests (Perform in Monitor Mode)						
	Verify low rate alarm at 45 BPM						
	Heart Rate reading at 50 BPM (SpO_2)	46	54				
	Heart Rate reading at 120 BPM (SpO_2)	116	124				
	Heart Rate reading at 80 BPM (SpO_2)	76	84				
	NIBP Tests (Function test in Monitor Mode)						
	Initial cuff inflation (Adult cuff)	161	195				
	Heart Rate reading @ 80 BPM (NIBP)	76	84				
	Inflate/ Deflate cycle time <120 seconds						
	Initial cuff inflation (Neonatal cuff)	94	151				

Appendix A (continued)

	Temperature Test (service or monitor mode - requires Alaris Temp Simulator)						
	Measured top Temp in ºF (98.6º nominal)	98.4	98.8				
	Measured top Temp in ºF (80.2º nominal)	79.9	80.5				
	Measured top Temp in ºF (107.8º nominal)	107.5	108.1				
	Measured bottom Temp in ºF (107.8º nominal)	107.5	108.1				
	Measured bottom Temp in ºF (80.2º nominal)	79.9	80.5				
	Measured bottom Temp in ºF (98.6º nominal)	98.4	98.8				
	Front Panel Key Tests (Perform in Service Mode)						
4.7.9	Verify appropriate responses to keypresses						
	Battery System Test (Perform in Monitor Mode)						
	Verify AC Mains indicator						
	Remove AC, Verify uninterrupted battery operation						
	Verify Battery LED is lit						
	Safety Testing						
	External DC to GND Resistance (m□)	0	1000				
	SpO2 leakage (µA)	0	150				
	Temp Leakage (µA)	0	50	d			
	ECG Leakage (µA)	0	50				
	Normal no-fault leakage (µA)	0	500				
	Normal open-ground leakage (µA)	0	500				
	Normal open-neutral leakage (µA)	0	500				
	Reverse no-fault leakage (µA)	0	500				
	Reverse open-ground leakage (µA)	0	500				
	Reverse open-neutral leakage (µA)	0	500				

Tested by: **Date:**

Signature: **Facility:**

MONITOR CONFIGURATION LOG - Appendix B

DINAMAP PRO 1000 Monitor Series

Note: Please refer to the PRO 1000 Pre-Service and Calibration Procedures for instructions.

Date: _____ City: _____

Hospital: _____

Serial Numbers:

_____ _____ _____ _____
_____ _____ _____ _____
_____ _____ _____ _____

How to Enter Configuration Mode

1. Choose **other system settings** from the **Main** Menu.
2. Choose **go to config mode**. The message **This will initiate the sequence for entering Configuration Mode. Do you want to do this?** appears.
3. Choose **Yes** to enter configuration mode.
4. The message **Please enter the Config Mode** password appears. Enter the password. FACTORY SET CONFIG PASSWORD: **2508**
5. Choose **Done**.
6. The system will restart in configuration mode. Press the SelectKnob to access the **Configuration** Menu.

How to Configure Default Tables

1. Choose **admit patient** from the **Configuration** Menu.
2. Choose **Choose patient settings**. Select the table you wish to configure (**default 1** through **default 6**).
3. A popup window appears: **All unsaved changes to the current default will be lost! Are you sure you want to do this?** Choose **Yes**.
4. Choose **Patient type** and select either **Adult, pediatric,** or **neonate.**
5. Change all other available settings as desired.
6. To save your changes for the selected table go to **other system settings**, choose **save default changes**.
7. A popup window appears: **Enter the name for this default**. Rename or accept the default table and choose **DONE**. Your data will be saved.
8. Repeat steps 1 through 7 for configuring the remaining five default tables.

How to Exit Configuration Mode

1. Choose **other system settings** from the **Configuration** Menu.
2. Choose **exit config mode**.
3. A popup window appears: **This will exit configuration mode. All unsaved changes will be lost. Are you sure you want to do this?** Choose **Yes**.
4. The system will automatically restart in patient monitoring mode.

Warning: All monitoring will cease when entering configuration mode. Do not enter this mode if actively monitoring a patient.

Default Table Name	Factory Default	Adult	Pediatric	Neonate	Adult2	Pediatric2	Neonate2
Adjust Alarms							
Adjust alarm volume (0 to 5)	4						
Choose autoset %	20%						
HR/Pulse	auto-set						
Config settings							
Alarm volume low range	1						
Alarm silence time (in min)	2						
Admit Patient							
Choose Patient settings	DEFAULT 1						
Patient type	adult						
enter bed number							
enter unit number							
View Patient Trends							
Choose graphs to print	0 chosen						
Display as	numbers						
View vitals every	NIBP						
Mini trends…							
View trends on main screen?	yes						
Display as	numbers						
View vitals every	NIBP						
Config Settings							
Save previous patient data?	yes						
Trend key default	mini trends						
Setup HR/Pulse							
Select source	auto						
Adjust QRS volume	0						
Adjust limits	auto-set						
hi	150						
lo	50						
Advanced settings…							
Limit alarms priority	warning						
Change color based on source?	yes						
Select HR/Pulse's color	light green						

(A=adult, P=pediatric, N=neonate. If not specified the factory default setting is the same for adult, pediatric, and neonate)

Setup ECG							
Lead selection	Lead II						
Waveform size	1X						
Pacer off?	PACE OFF						
Arrhythmia detection	yes						
Advanced settings…							
Cardiac sweep speed	25.0 mm/s						
Cascade ECG?	no						
Display filter	0.5 to 40 Hz						
other alarm priorities							
VTACH	crisis						
lead fail	procedural						
Replace electrodes	procedural						
Artifact	message						
Select EKG's color	light green						
Config settings…							
Fixed ECG sweep speed?	no						
Setup NIBP							
Auto BP	Manual						
setup custom series							
1st BP Series	q 10 mins						
repeat	x3						
2nd BP Series	q 30 mins						
repeat	x3						
3rd BP Series	q 60 mins						
repeat	x3						
4th BP Series	q 120 mins						
repeat	x3						
Adjust limits	auto-set						
systolic hi	A=200, P=150, N=100						
lo	A=80, P=70, N=40						
diastolic hi	A=120, P=90, N=60						
lo	A=30, P=30, N=20						
mean hi	A=140, P=100, N=70						
lo	A=40, P=40, N=30						
Advanced settings…							
Initial target pressure	auto						

(A=adult, P=pediatric, N=neonate. If not specified the factory default setting is the same for adult, pediatric, and neonate)

Setup NIBP (continued)							
Limit alarms priority	warning						
other alarm priorities							
No determination	procedural						
Overpressure	procedural						
Pump timeout	procedural						
Total timeout	procedural						
Level timeout	procedural						
Select NIBP's color	purple						
Setup SpO2							
View Waveform?	yes						
Adjust limits	hi 100 lo 90						
Advanced settings…							
View signal strength bar?	yes						
View SpO2 PR?	no						
Spot check enable	yes						
Cardiac sweep speed	25.0 mm/s						
Limit alarms priority	warning						
other alarm priorities							
Lost pulse	procedural						
Sensor disconnected	procedural						
Replace cable	procedural						
Select SpO2's color	white						
Setup RESP							
Lead to analyze	**A**-LII, **P**-LII, **N** - L1						
View waveform?	yes						
Waveform size	1X						
Adjust limits hi	A=30, P=60, N=100						
lo	A=6, P=10, N=15						
Advanced settings...							
Resp sweep speed (mm/s)	A/P=12.5, N=6.25						
Cardiogenic filter	auto						
Limit alarms priority	warning						
other alarm priorities							
Resp approaching	warning						
Lead Fail	procedural						
Saturation	procedural						

(A=adult, P=pediatric, N=neonate. If not specified the factory default setting is the same for adult, pediatric, and neonate)

Setup RESP (continued)							
Artifact	procedural						
Select RESP's color	procedural						
Config settings…							
Turn on RESP with ECG?	no						
Setup TEMP							
Unit of Measure	°F						
Choose mode	predictive						
Advanced Settings…							
other alarm priorities							
Disconnected	procedural						
Two probes out	procedural						
Timed out	procedural						
Probes same type	procedural						
Check probes	procedural						
Select TEMP's color	yellow						
Config settings…							
Allow °C units only?	no						
Setup RECORDER							
print on alarm	no						
vitals summary on printout	no						
Auto printout of vitals summary	OFF						
setup continuous							
Waveforms to record	1 chosen						
setup timed							
Chart speed	25.0 mm/s						
Length of strip (in seconds)	8						
Record key printout	at bedside						
Config settings…							
setup continuous							
Delayed memory (in seconds)	8						
Length of strip (in seconds)	20						
setup timed							
Delayed memory (in seconds)	4						

(A=adult, P=pediatric, N=neonate. If not specified the factory default setting is the same for adult, pediatric, and neonate)

Other System Settings							
Always display battery icon?	no						
Advanced Settings…							
Select color format	full color						
Adjust keyclick volume	2						
Adjust system volume	8						
Config settings…							
Select date format	mm/dd/yy						
Select time format	military						
Language	english						
Display units?	yes						
Display limits?	yes						
Config HostComm							
Unit address	" "						
IP address	2.0.0.0						
Waveforms to send	2 chosen						
Remote access	OFF						
Serial 1 setup							
Startup mode	ASCII cmd						
Baud rate	9600						
Serial 2 setup							
Startup mode	ASCII cmd						
Baud rate	9600						

(A=adult, P=pediatric, N=neonate. If not specified the factory default setting is the same for adult, pediatric, and neonate)

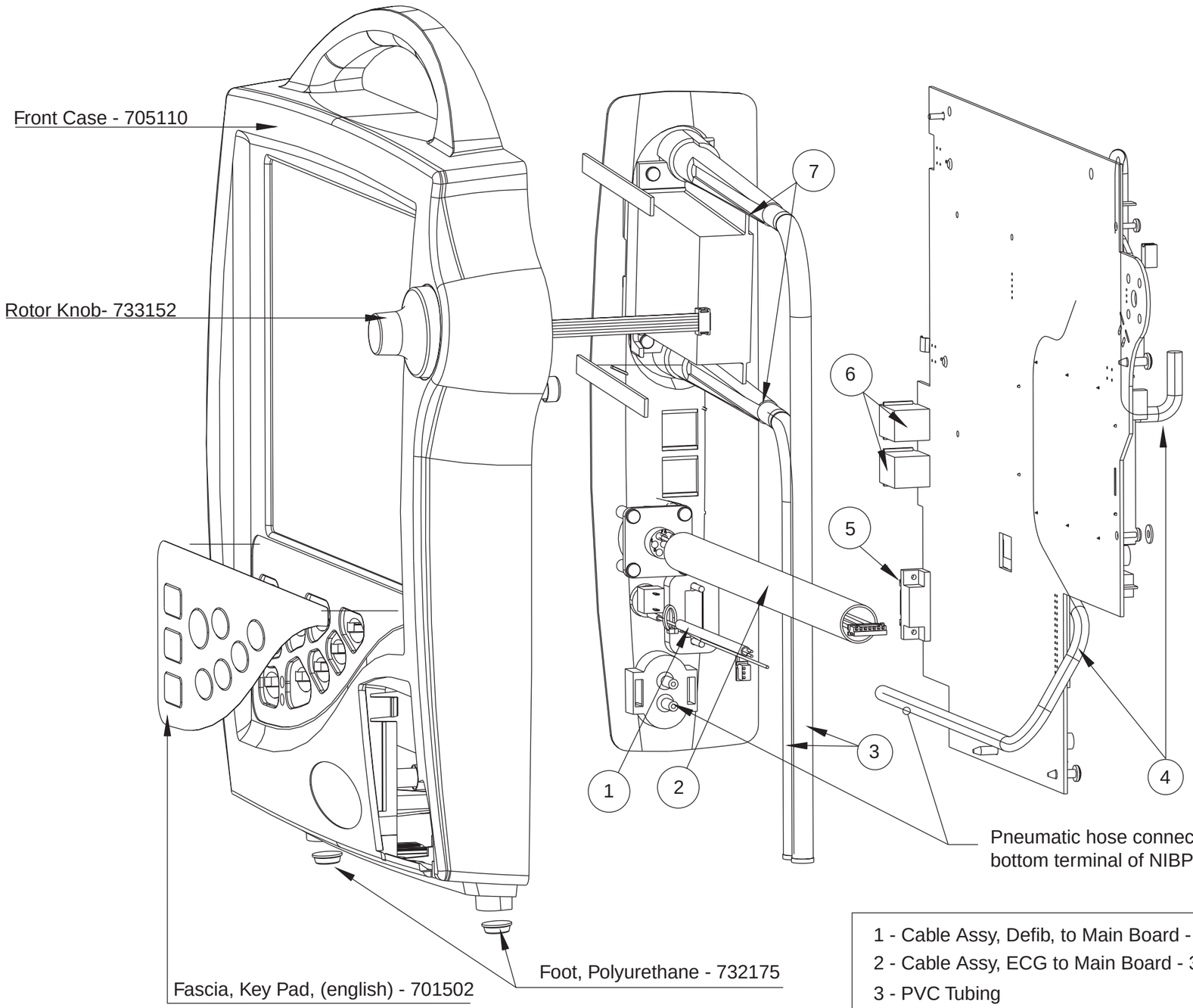
Notes

Columns that are grayed out are non-configurable.

SECTION 5 ASSEMBLY DRAWINGS & ELECTRICAL SCHEMATICS

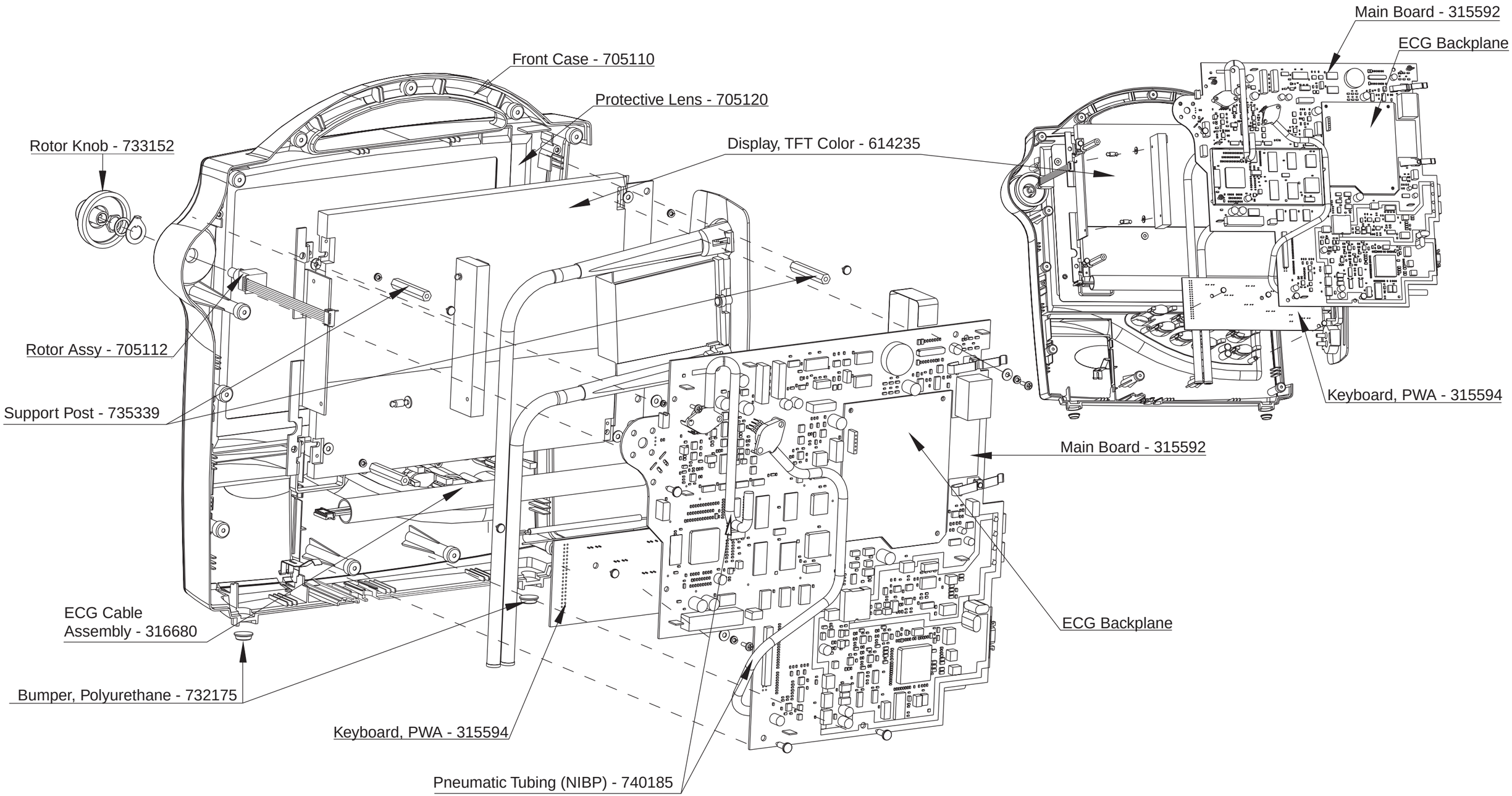
Assembly Drawings (Monitor Assembly & Disassembly)
Front Case 1 ..... 5-1/2
Front Case 2 ..... 5-3/4
Rear Case 1 ..... 5-5/6
Rear Case 2 ..... 5-7/8

Electrical Schematics
ECG Board – 315589 ..... 5-9 through 5-18
Main Board – 315592 ..... 5-19 through 5-42
Power Supply Board – 315593 ..... 5-43 through 5-52
Keyboard 5-53/54
Probe Warmer 5-55/56



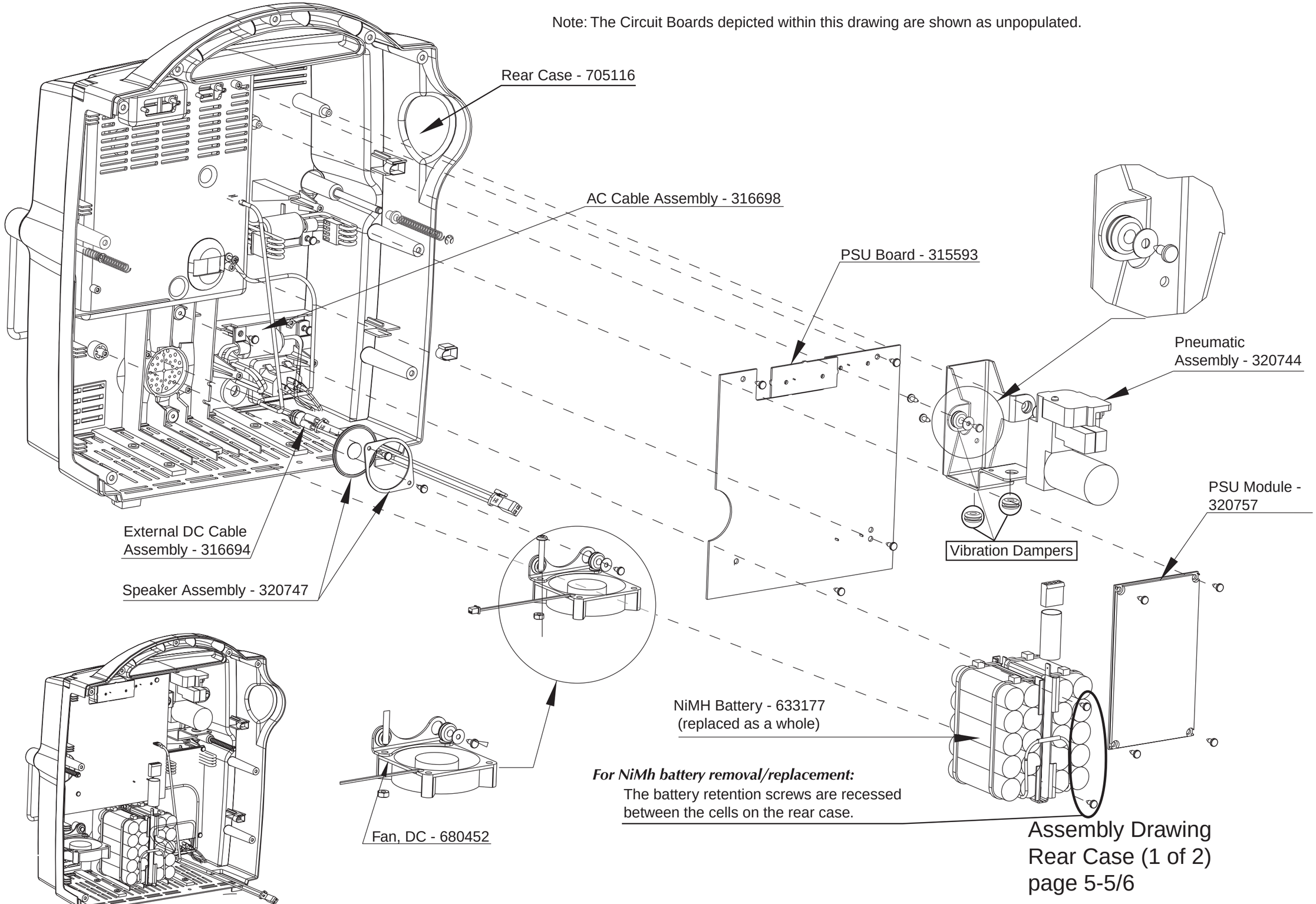
1 - Cable Assy, Defib, to Main Board - 316701
2 - Cable Assy, ECG to Main Board - 316680
3 - PVC Tubing
4 - Pneumatic Tubing (NIBP) - 740185
5 - Nellcor SpO2 Connector - 608530
6 - Alaris Temperature Connectors - 608531
7 - Temp Probe Housing - 705108

Assembly Drawing
Front Case (1 of 2)
page 5-1/2



Assembly Drawing -
Front Case (2 of 2)
page 5-3/4

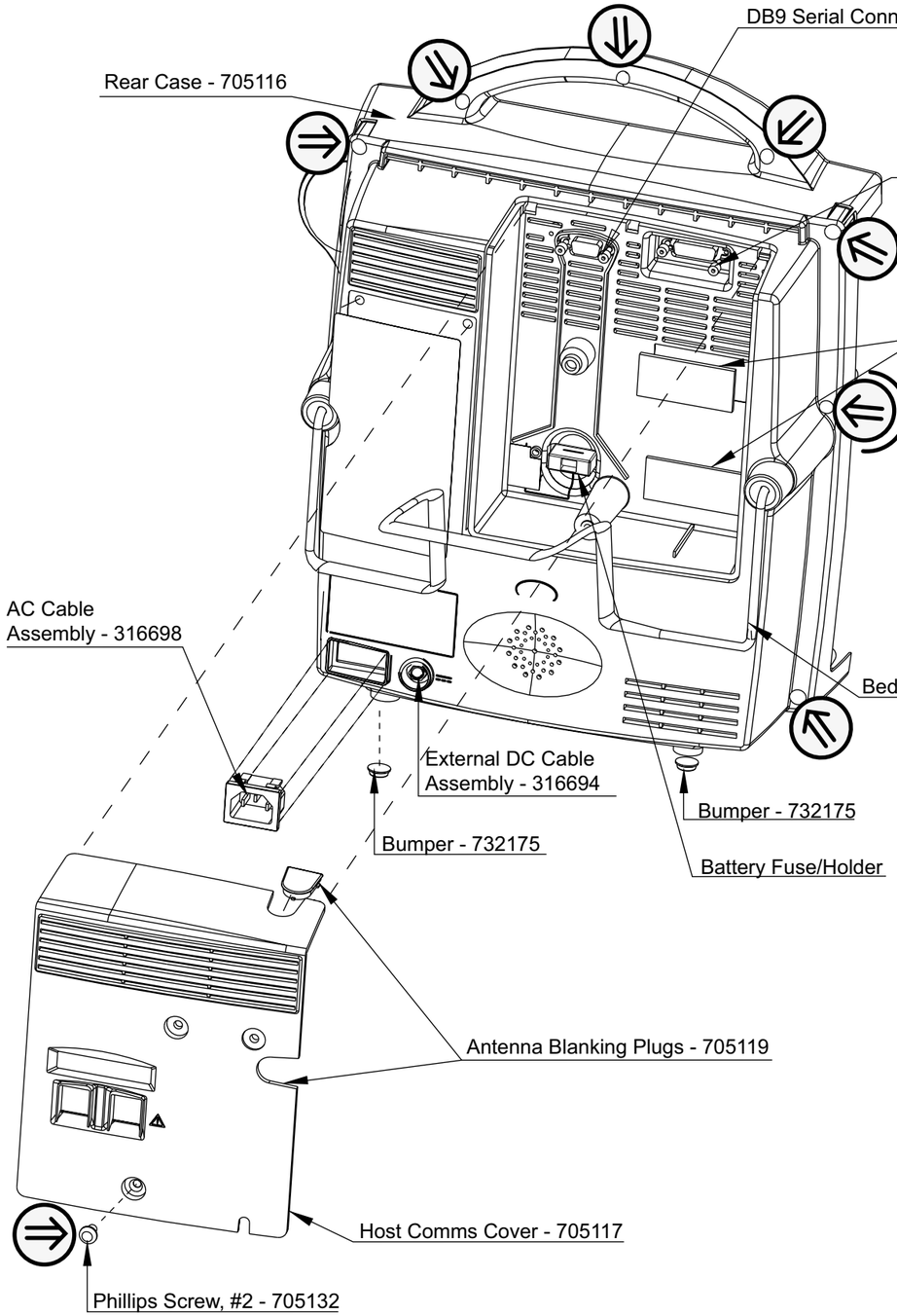
Note: The Circuit Boards depicted within this drawing are shown as unpopulated.

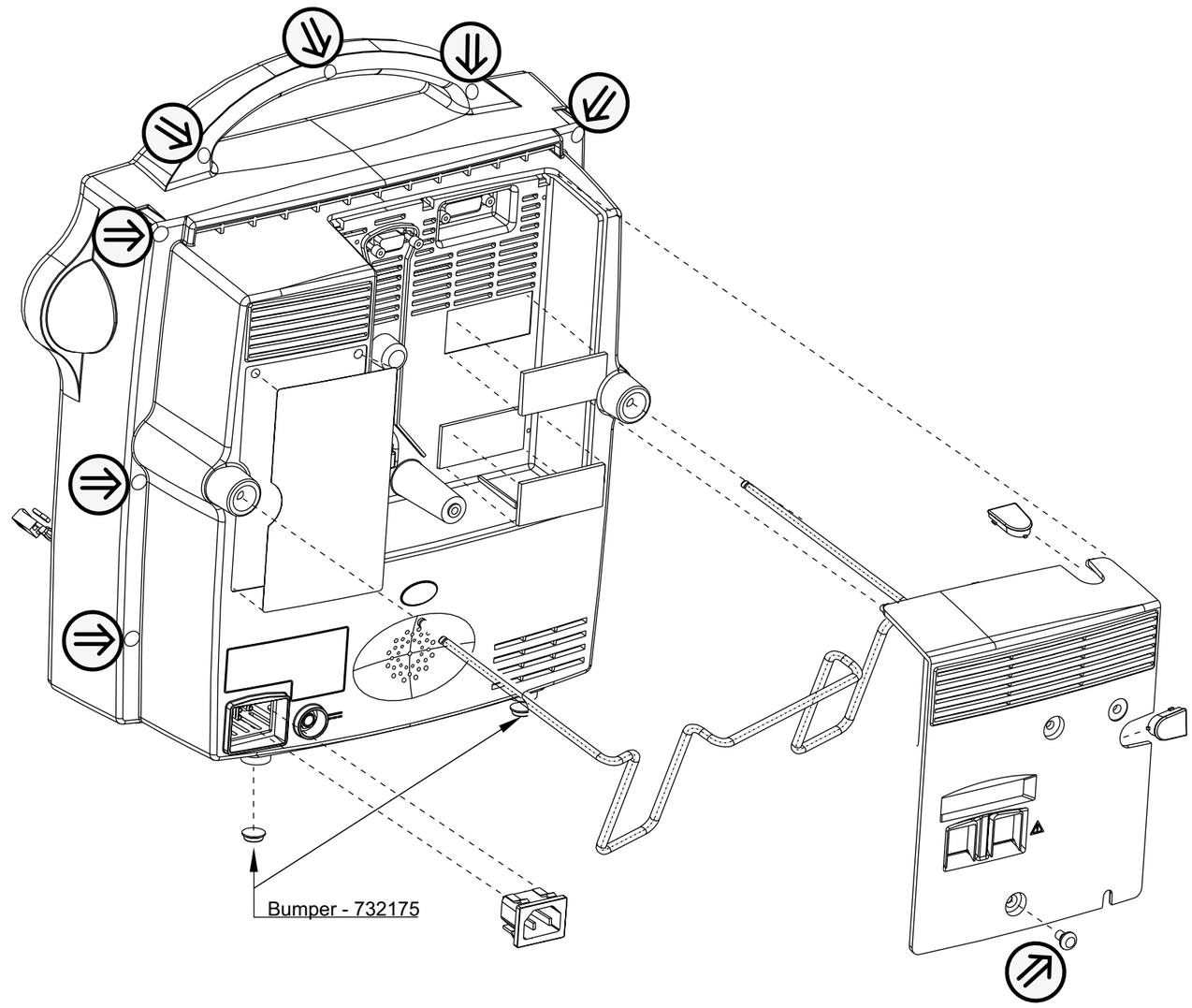


For NiMh battery removal/replacement:

The battery retention screws are recessed between the cells on the rear case.

Assembly Drawing
Rear Case (1 of 2)
page 5-5/6

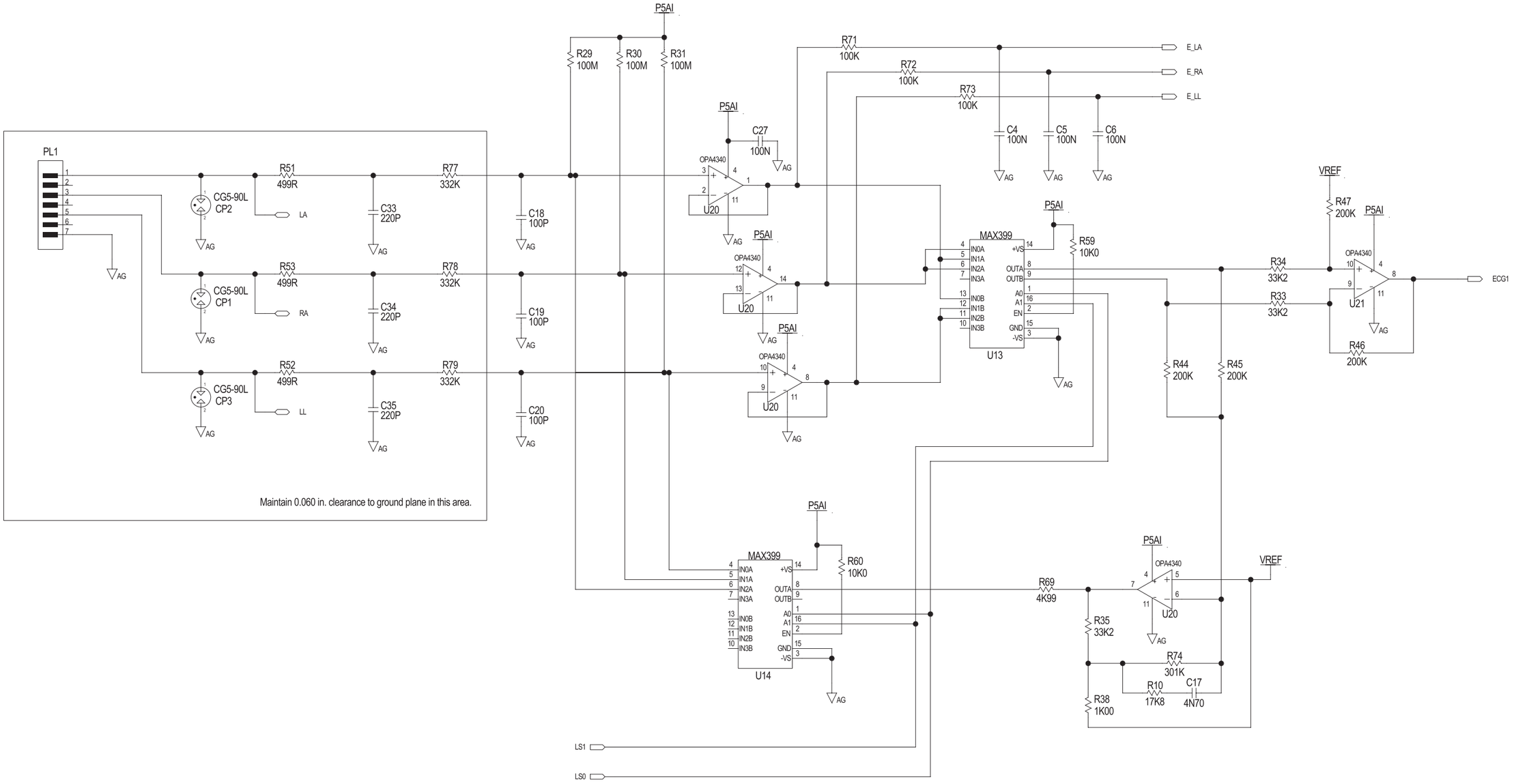




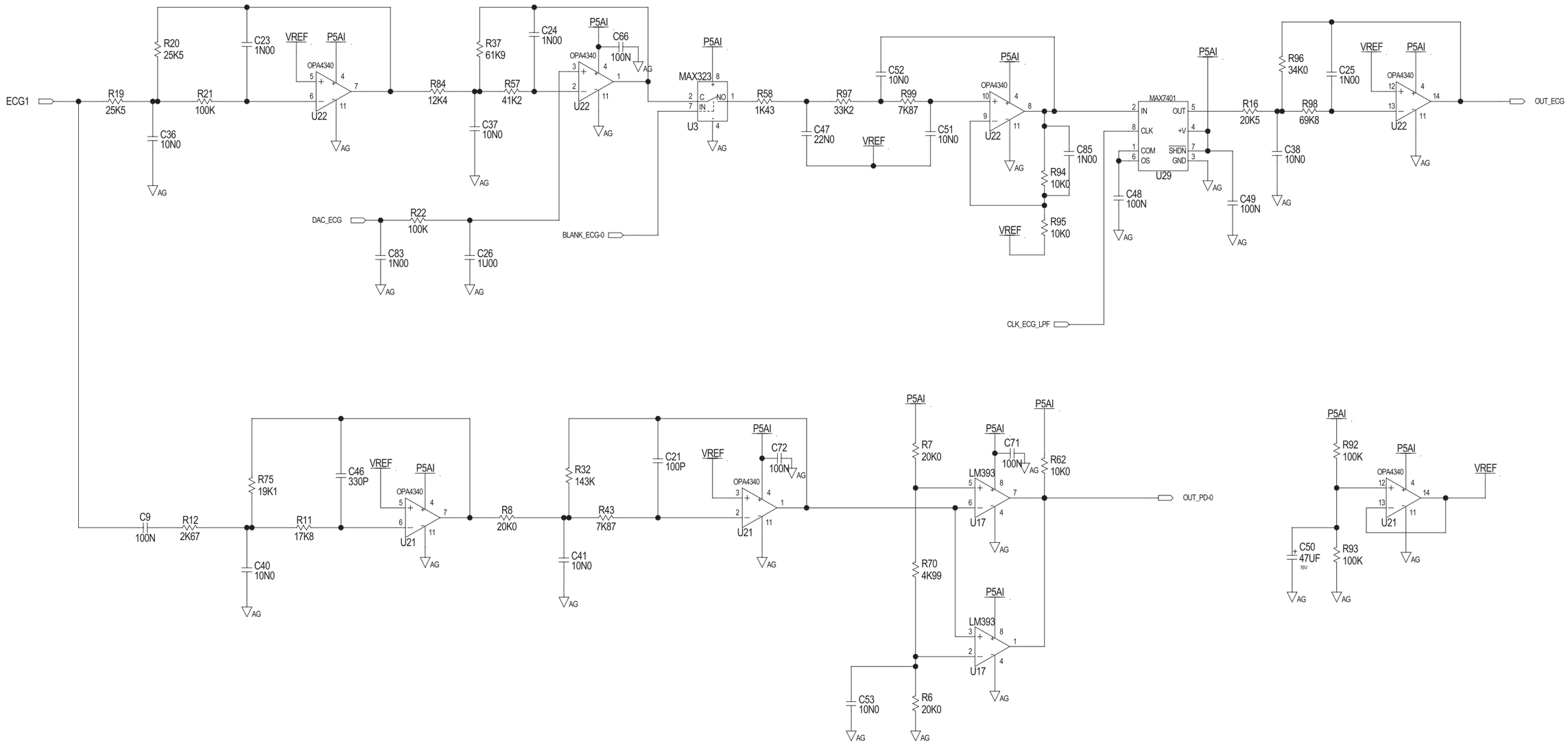
- Indicates a screw removal point.

Note 1: This particular screw is longer than all of the other screws. It is critical to return this screw to the same slot; placement elsewhere can potentially cause damage to the front of the Monitor, requiring case replacement.

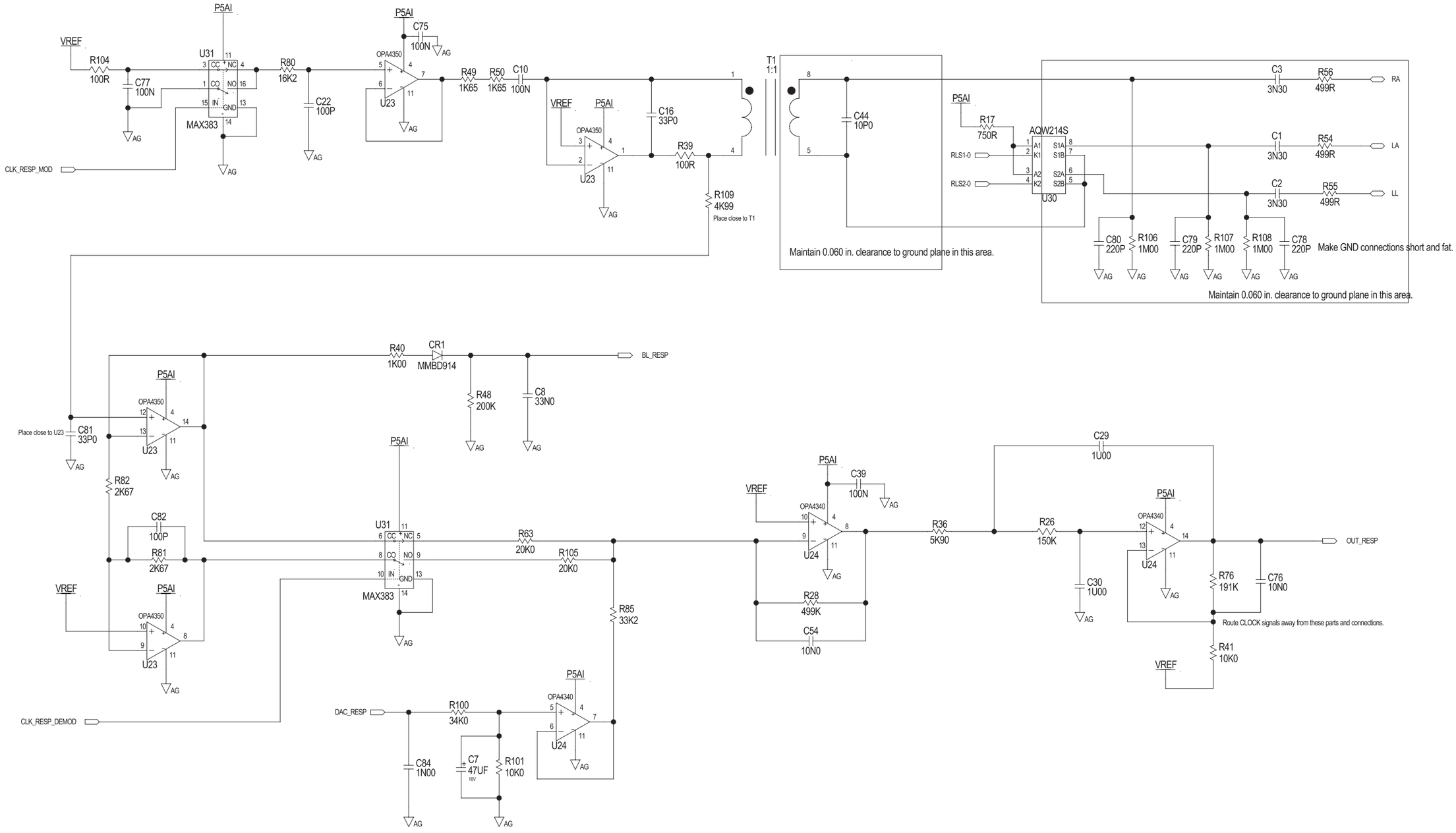
Assembly Drawing
Rear Case (2 of 2)
Host Comms Cover removed
page 5-7/8



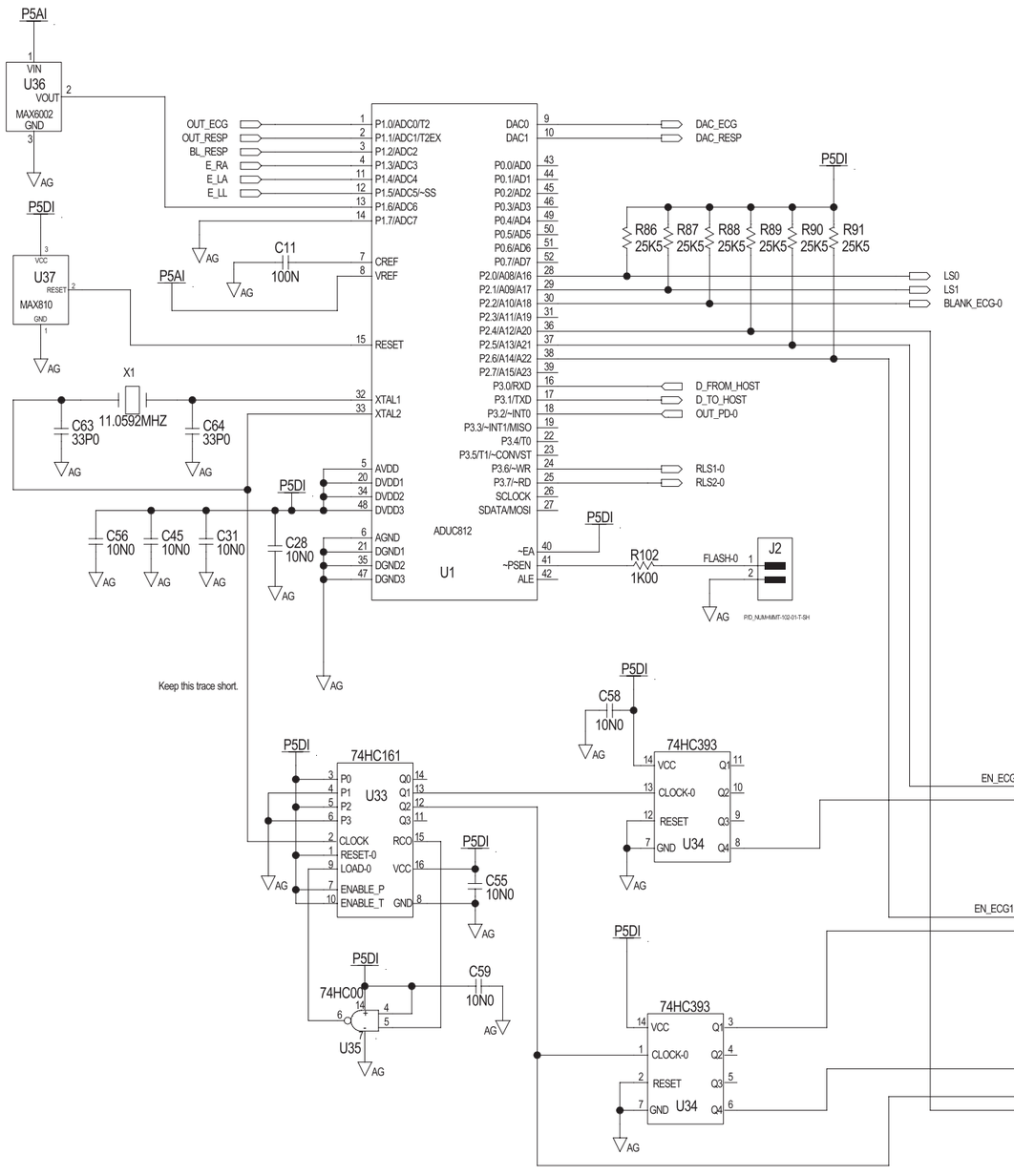
Schematic - ECG Board
P/N 315589 (1 of 5)
page 5-9/10

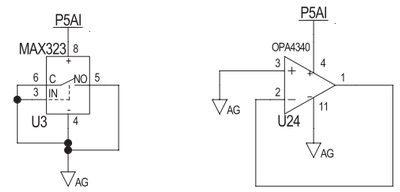


Schematic - ECG Board
P/N 315589 (2 of 5)
page 5-11/12



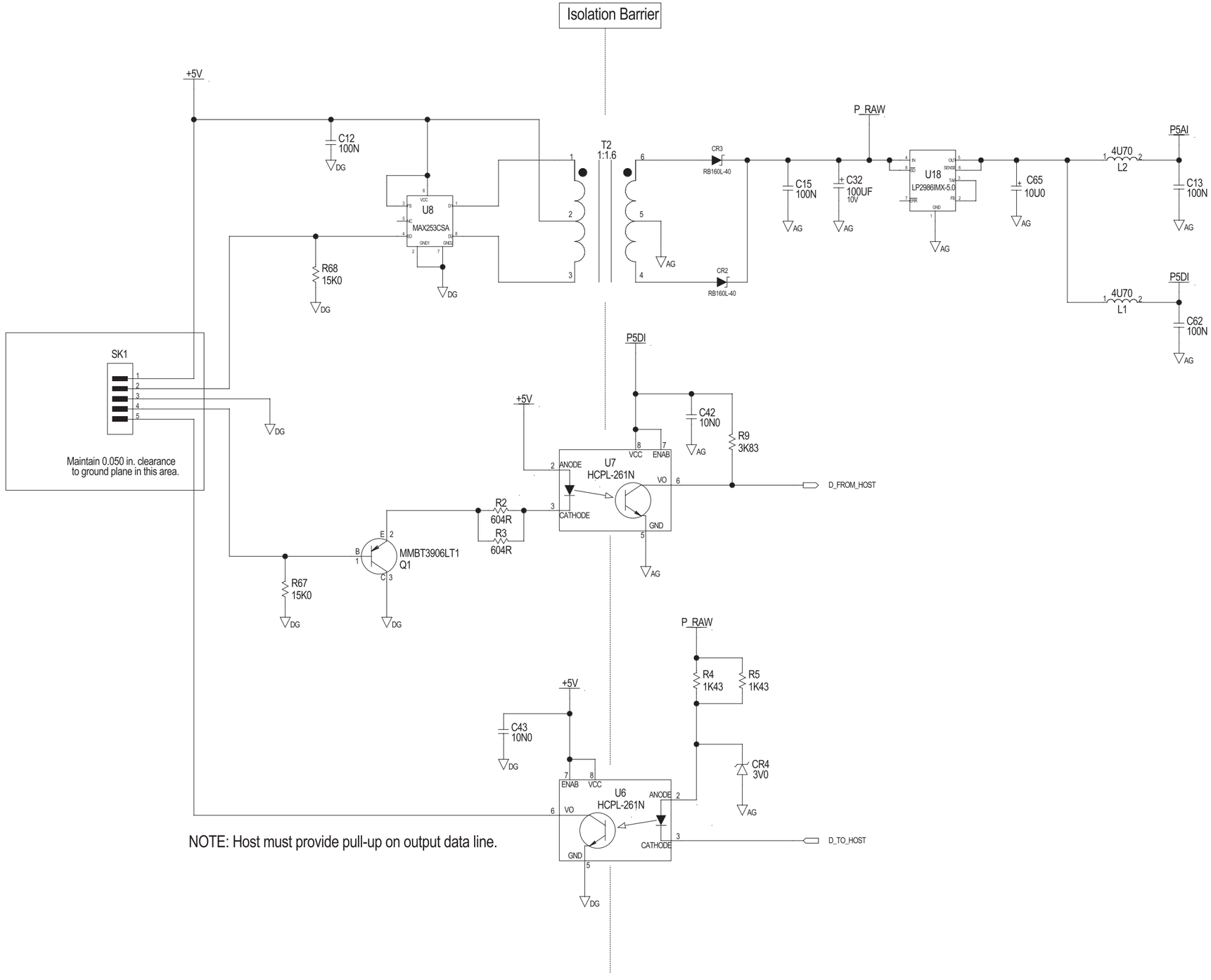
Schematic - ECG Board
P/N 315589 (3 of 5)
page 5-13/14





Spare Parts

Schematic - ECG Board
P/N 315589 (4 of 5)
page 5-15/16



NOTE: Host must provide pull-up on output data line.

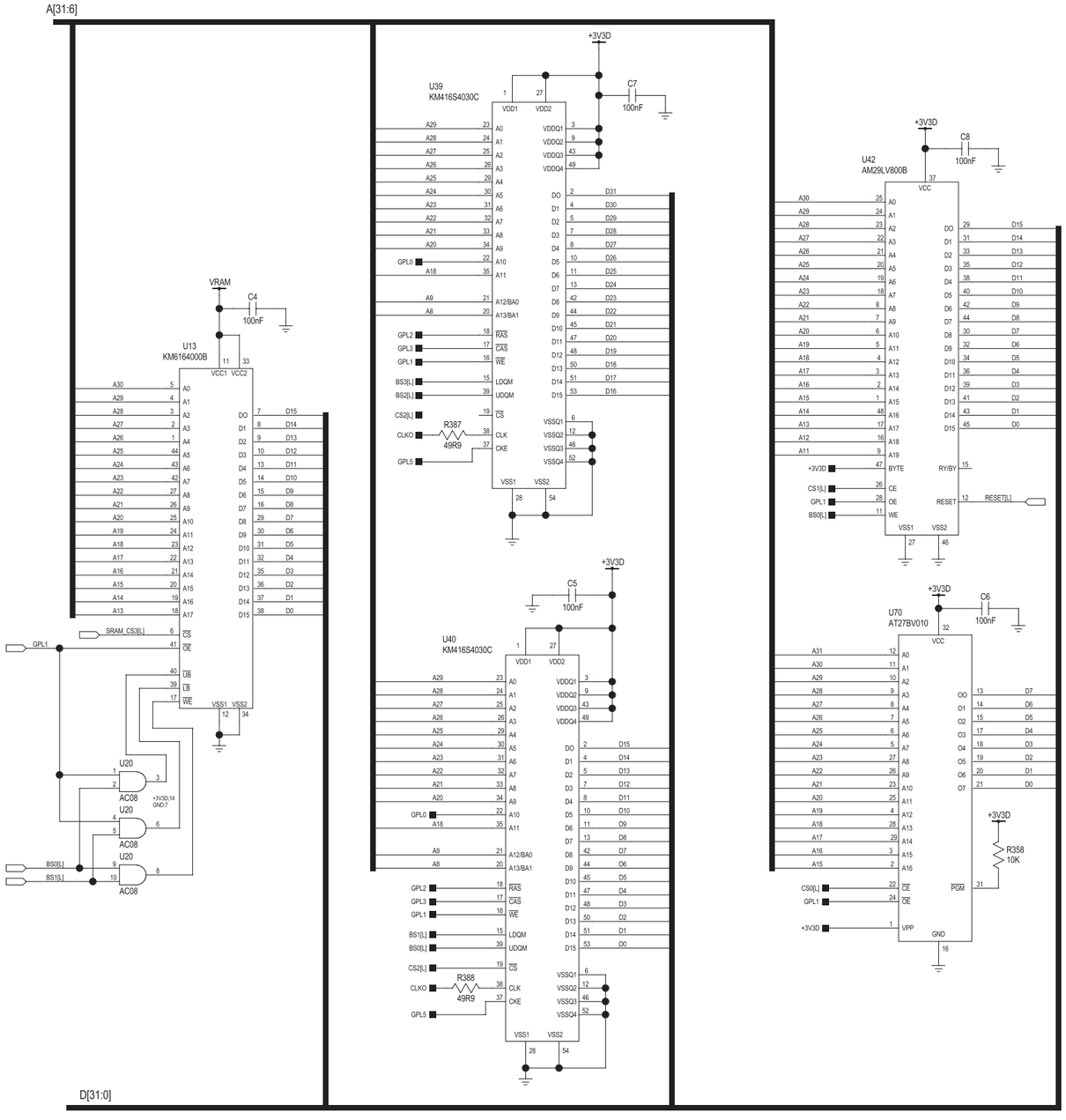
Schematic - ECG Board
P/N 315589 (5 of 5)
page 5-17/18

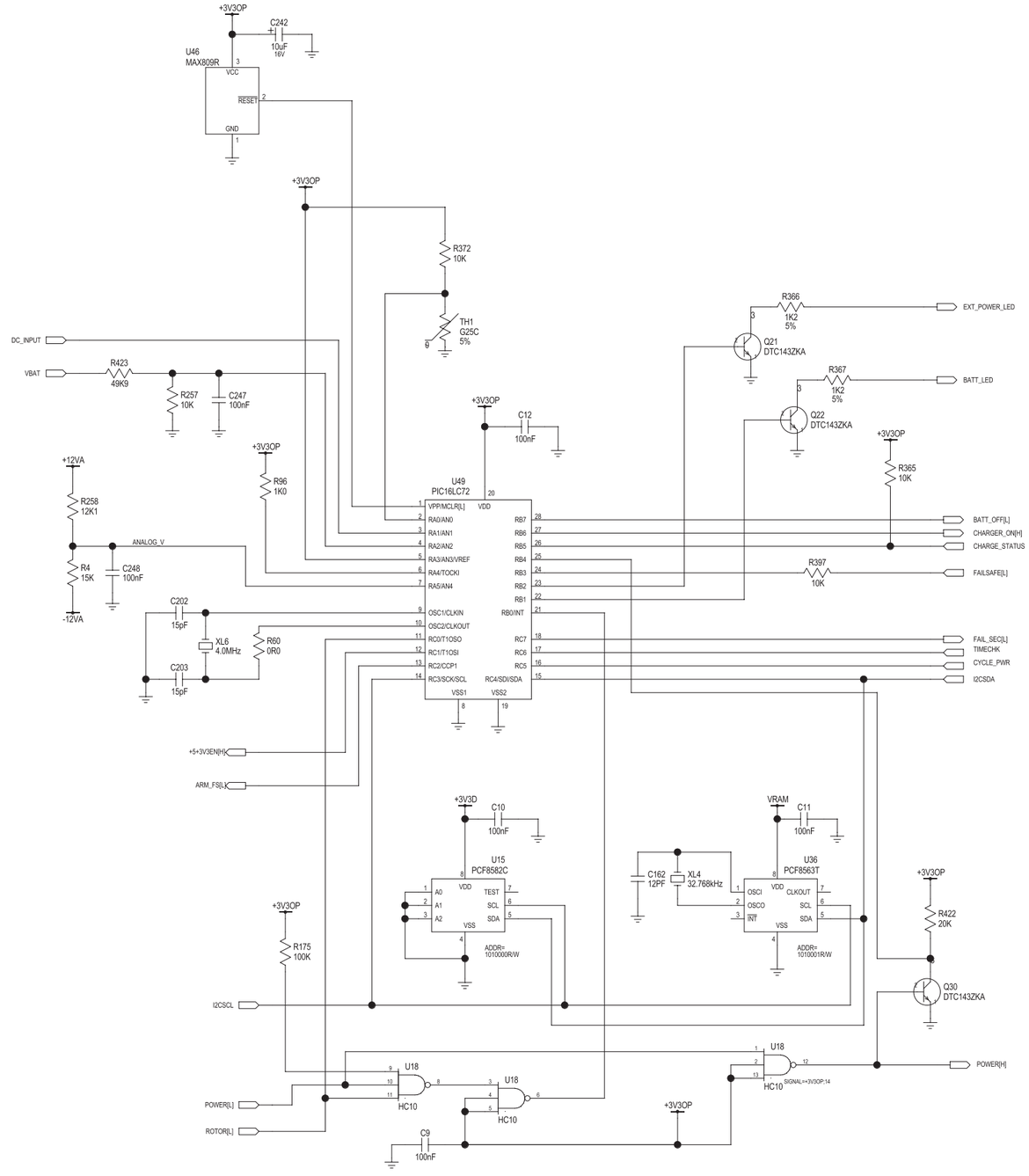
U12
MPC823

A[31:6]

D[31:0]

Schematic - Main Board
P/N 315592 (1 of 12)
Page 5-19/20

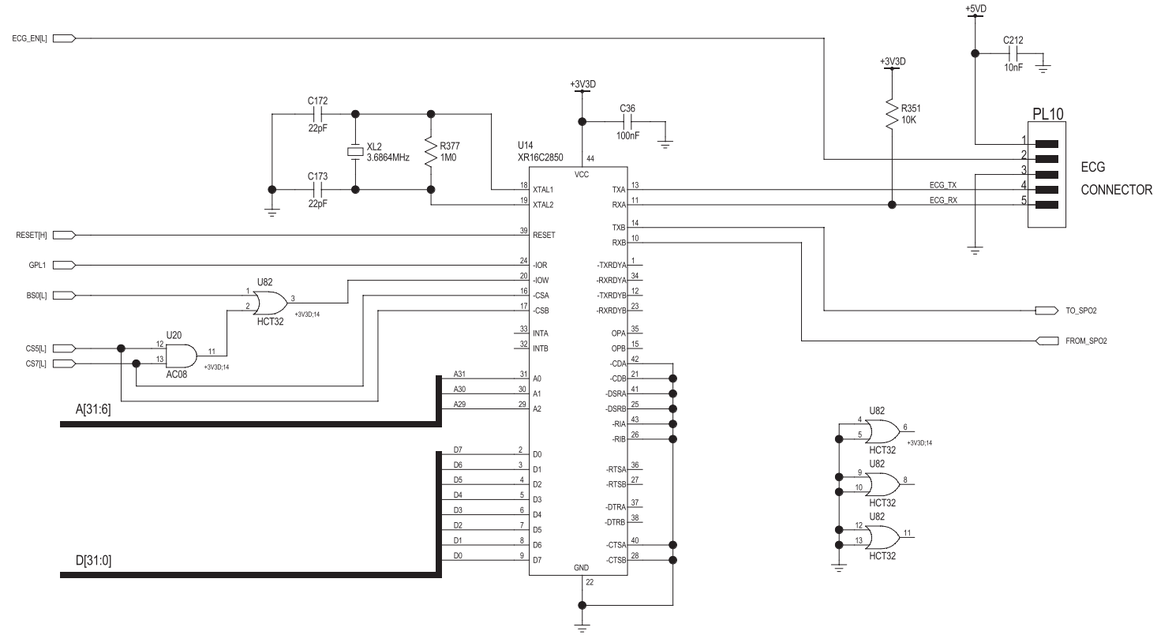




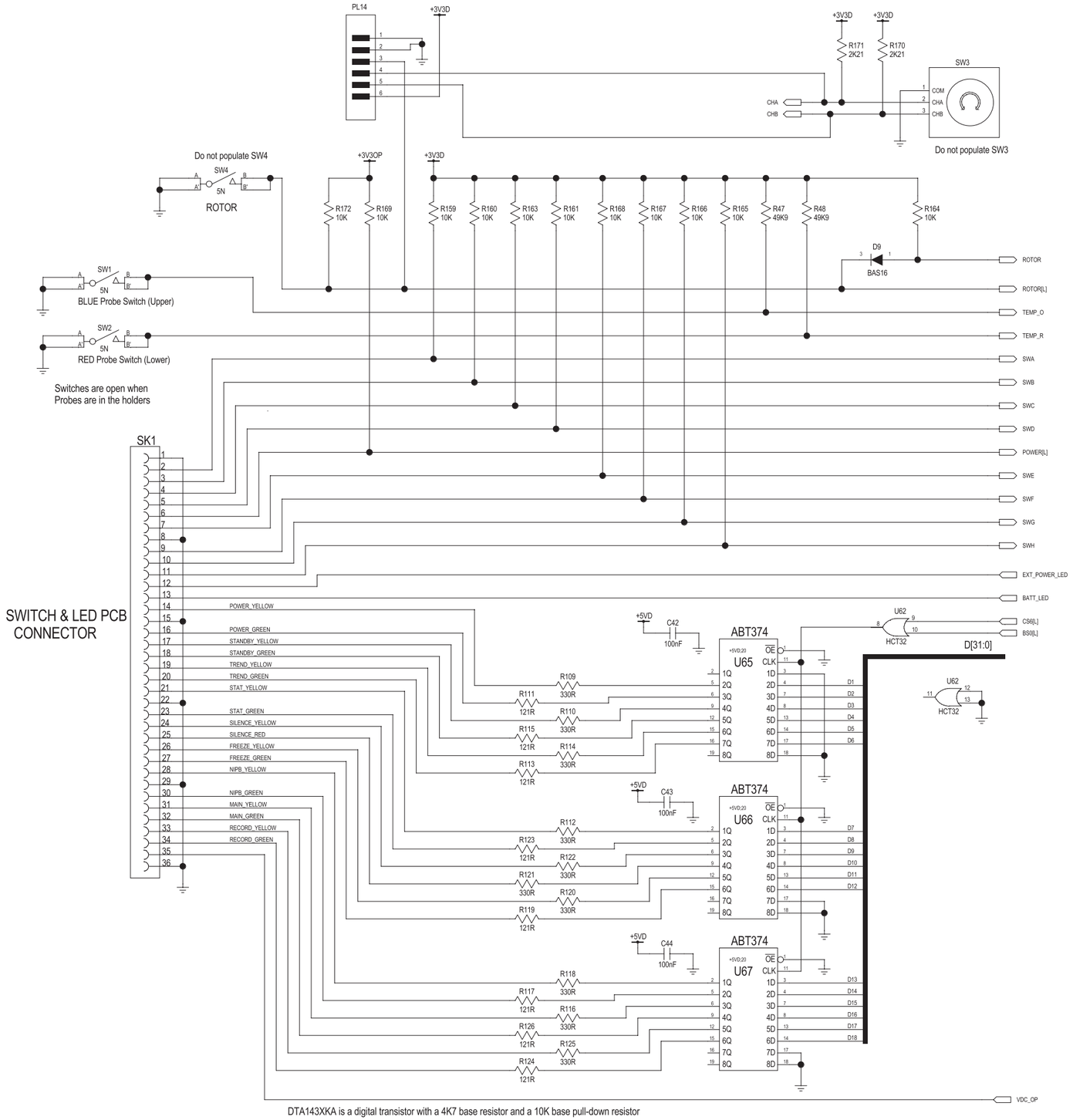
Schematic - Main Board
P/N 315592 (2 of 12)
Page 5-21/22

U57 AD822
+12VA
R80 21K 0.1%
R274 30K
R156 10K
R18 750R 0.1%
C27 100nF
R91 18K
R6 3K3
C106 470nF
C144 47nF
C231 100nF
U75 AD822
VBAT
R407 1M0
R408 100K
C140 2u2 25V
C17 100nF
ANA+
C161 330nF
U54 LM78L12
U56 LM78L05
C208 47uF 35V
C26 100nF
C117 10uF 16V
C25 100nF
R2 10R
C116 10uF 16V
CR1
BAT54S
PT1 MPX2050
VS
VOUT+
VOUT-
GND
C14 100nF
R93 549R 0.1%
U47 AD620
C29 100nF
C31 100nF
-12VA
PT2 MPX2050
C32 100nF
R94 549R 0.1%
U48 AD620
C33 100nF
C34 100nF
R81 21K 0.1%
R19 750R 0.1%
C35 100nF
U58 AD822
PUMPC
R384 1K0
C232 100nF
U55 DG408
C15 100nF
U58 AD822
R13 510R
C101 1nF
TH_REF
PT2
PT2_REF
PT1
PT1_REF
A0
A1
A2
EN
DGND
V+
V-
C16 100nF
+5VD
C13 100nF
U24 HCT174
R389 10K
C28 100nF
U61 HCT32
U62 HCT32
C211 100nF
ANA_SEL
C174 47uF 16V
C18 100nF
CONV_ST[L]
RD_RES[L]
C118 10uF 16V
+3V3D
C119 10uF 16V
U29 LTC1604
AIN+
AIN-
VREF
REFCOMP
SHDN
CS
CONV
RD
BUSY
DVDD
DGND
OVDD
OGND
AVDD1
AVDD2
VSS
D0
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15
R61 0R0
C24 100nF
C120 10uF 16V
U30 LM79L12
U33 LM79L05
C206 47uF 35V
C207 47uF 35V
C160 330nF
C23 100nF
ANA-
-12VA
ADC_BUSY[L]
BS0[L]
D[31:0]
A[31:6]
U51 HCT259
PNEU_CS[L]
ADC_NAP[L]
ADULT[L]
12V_ON[H]
DEFLATE
DUMP[L]
PUMP_ON
DEFIBEN[L]
ECG_EN[L]
C30 100nF
RESET[L]
NIBPCS[L]
U17 REF-01
TRIM
VIN
VOUT
GND
C20 100nF
R14 21K 0.1%
10K VR2
CW
R24 90K9 0.1%
ADULT OP Adjust
R52 10K 0.1%
C19 100nF
U59 AD822
R73 10K 0.1%
R16 9K09 0.1%
R15 41K2
VR1 10K
NEO OP Adjust
Q7 2N7002
R46 49K9
C21 100nF
R1 10R
R304 1M0
U53 LM393
R421 1K0
R275 30K
C22 100nF
R98 1K0
D5 BAS16
R305 330K
C130 1uF 16V
R157 10K
R26 10M 5%
R158 10K
R92 68K1
R306 20K
R70 15K
R105 27K4
UNFIL_0VPSV[L]
UNFIL_0VP[L]
FLT_0VP[L]

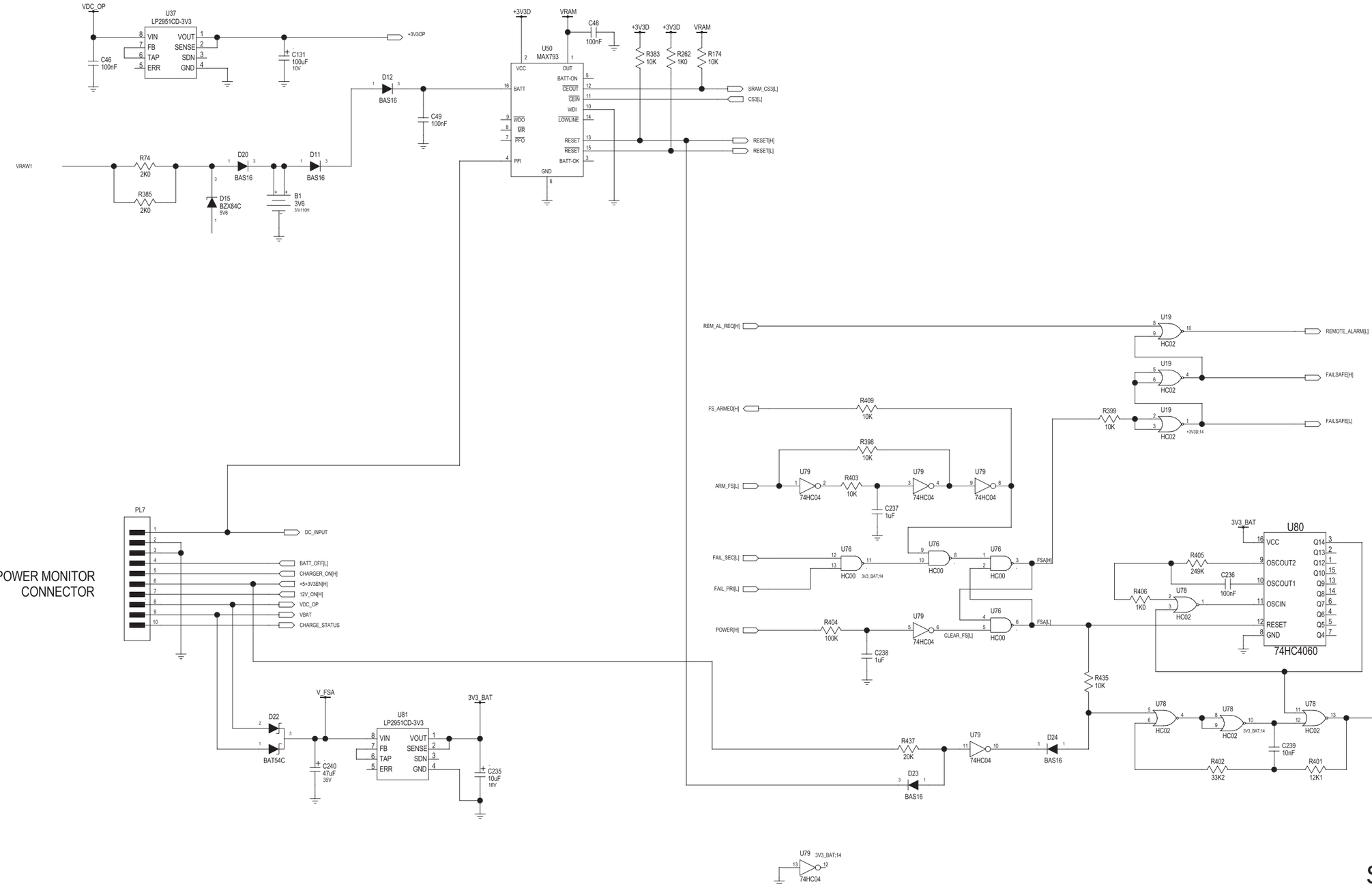
Schematic - Main Board
P/N 315592 (3 of 12)
Page 5-23/24



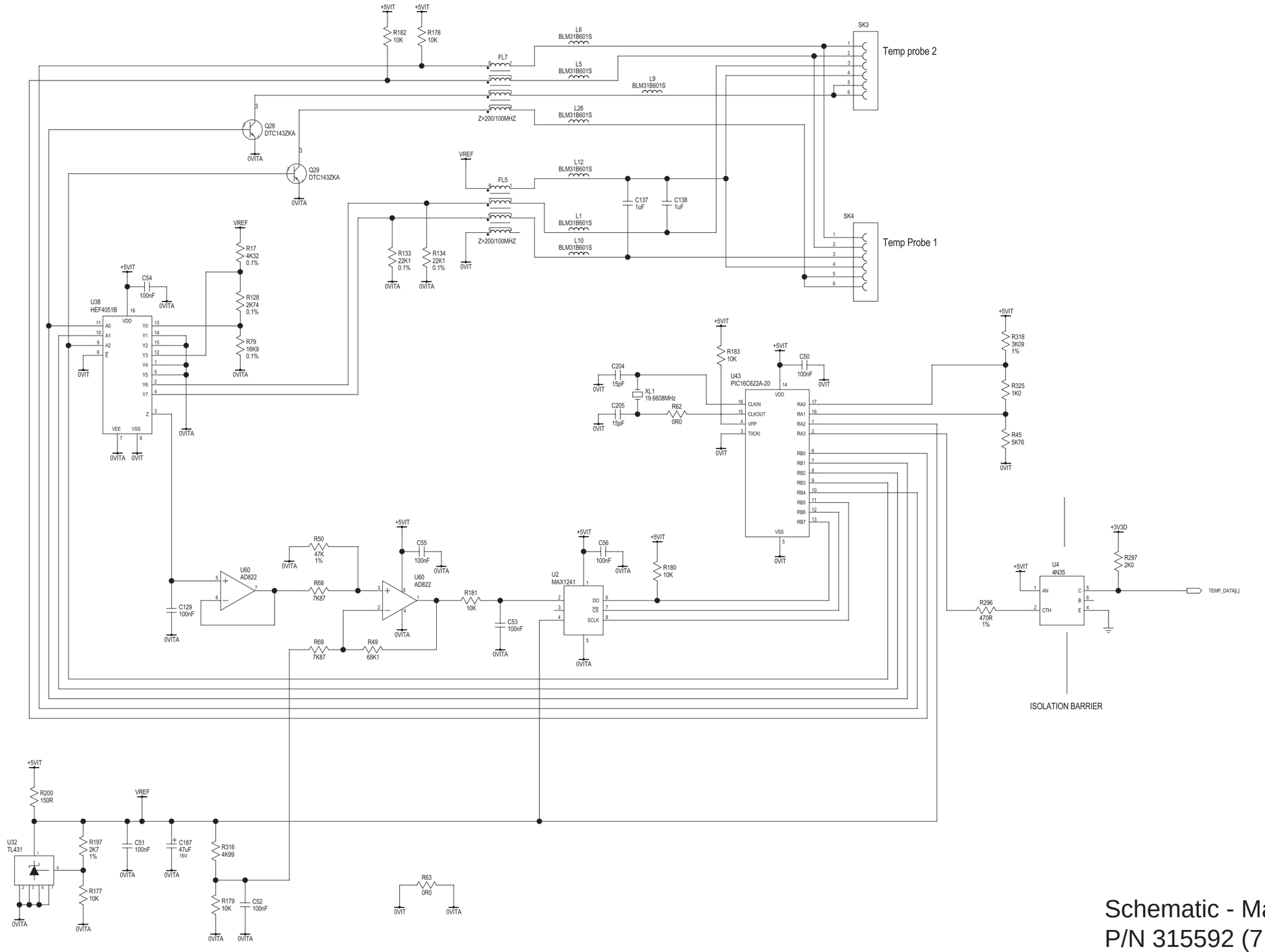
Schematic - Main Board
P/N 315592 (4 of 12)
Page 5-25/26



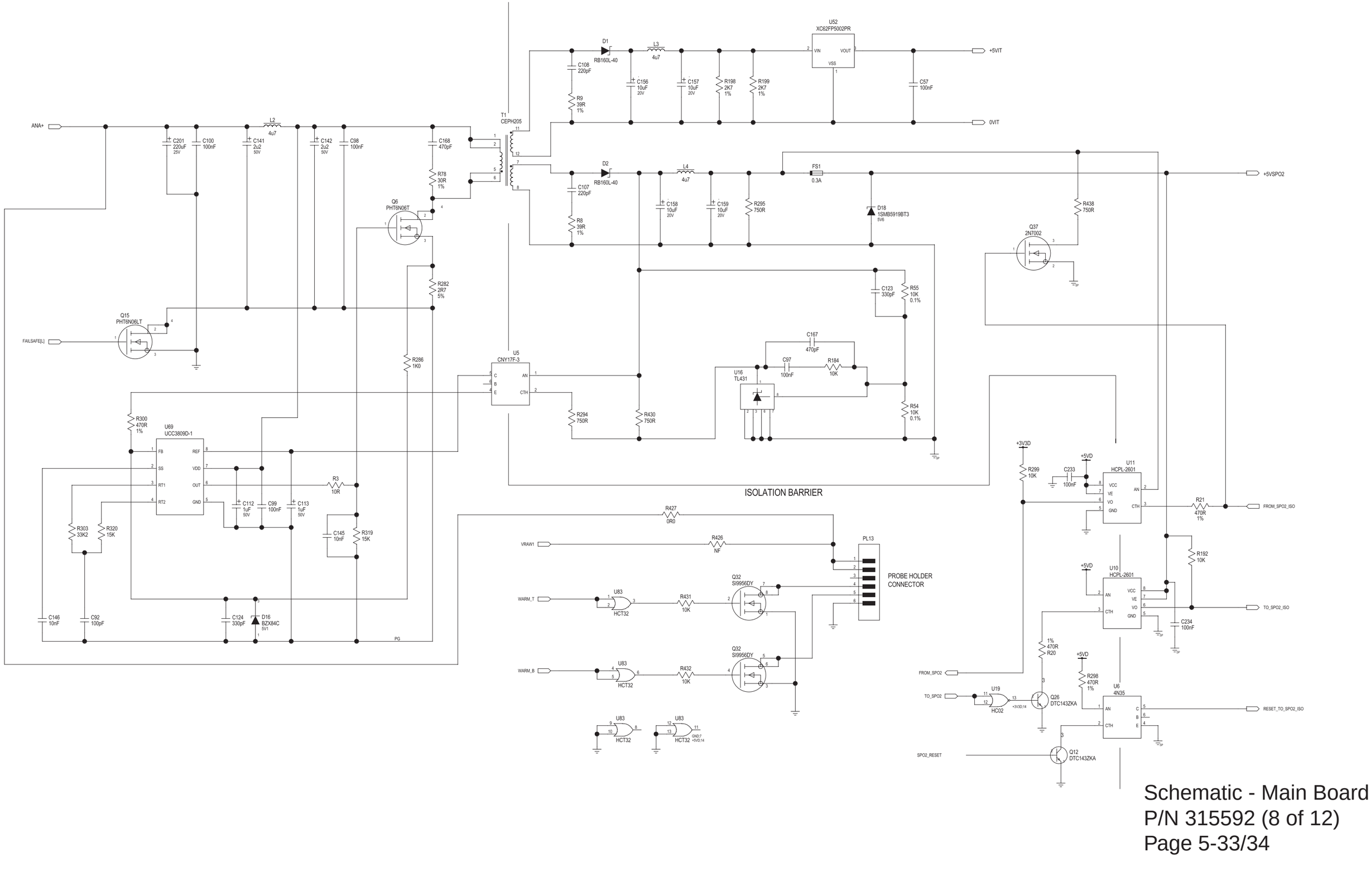
Schematic - Main Board
P/N 315592 (5 of 12)
Page 5-27/28



DTC143ZKA is a digital transistor with a 4K7 base resistor and a 47K base pull-down resistor

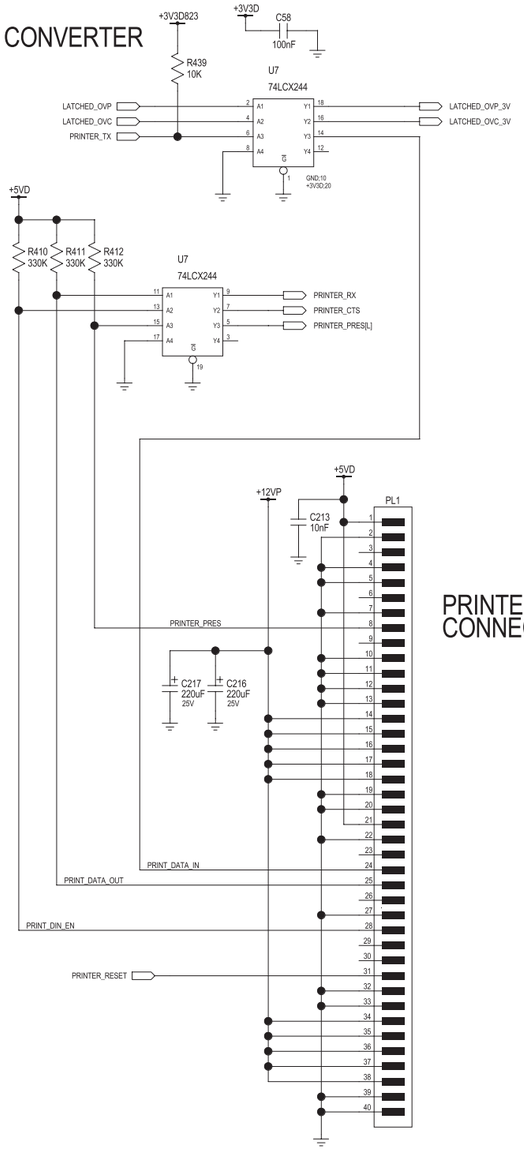


Schematic - Main Board
P/N 315592 (7 of 12)
Page 5-31/32

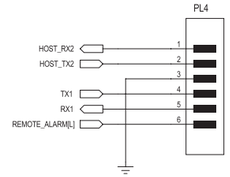


Schematic - Main Board
P/N 315592 (8 of 12)
Page 5-33/34

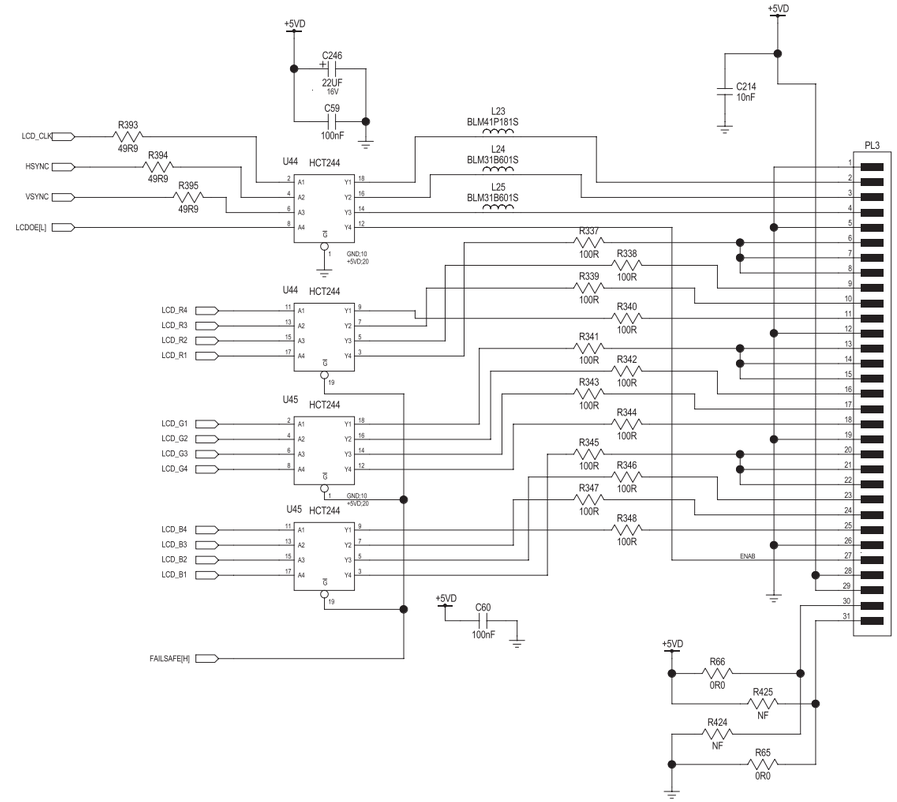
5V-3.3V CONVERTER



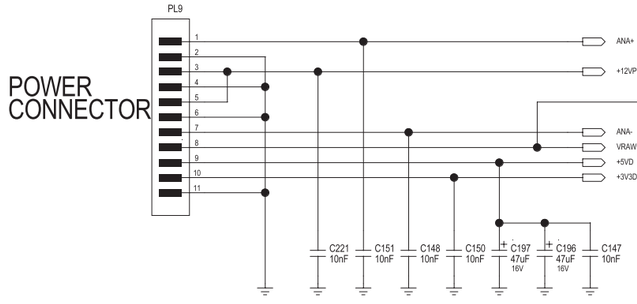
PRINTER CONNECTOR



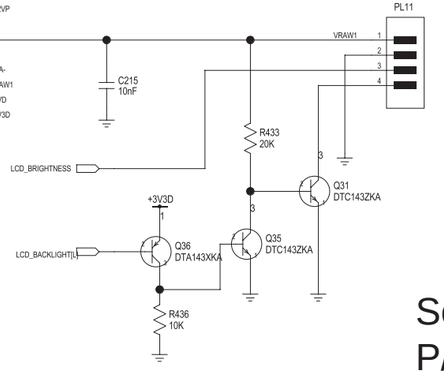
HOST CONNECTOR



LCD CONNECTOR

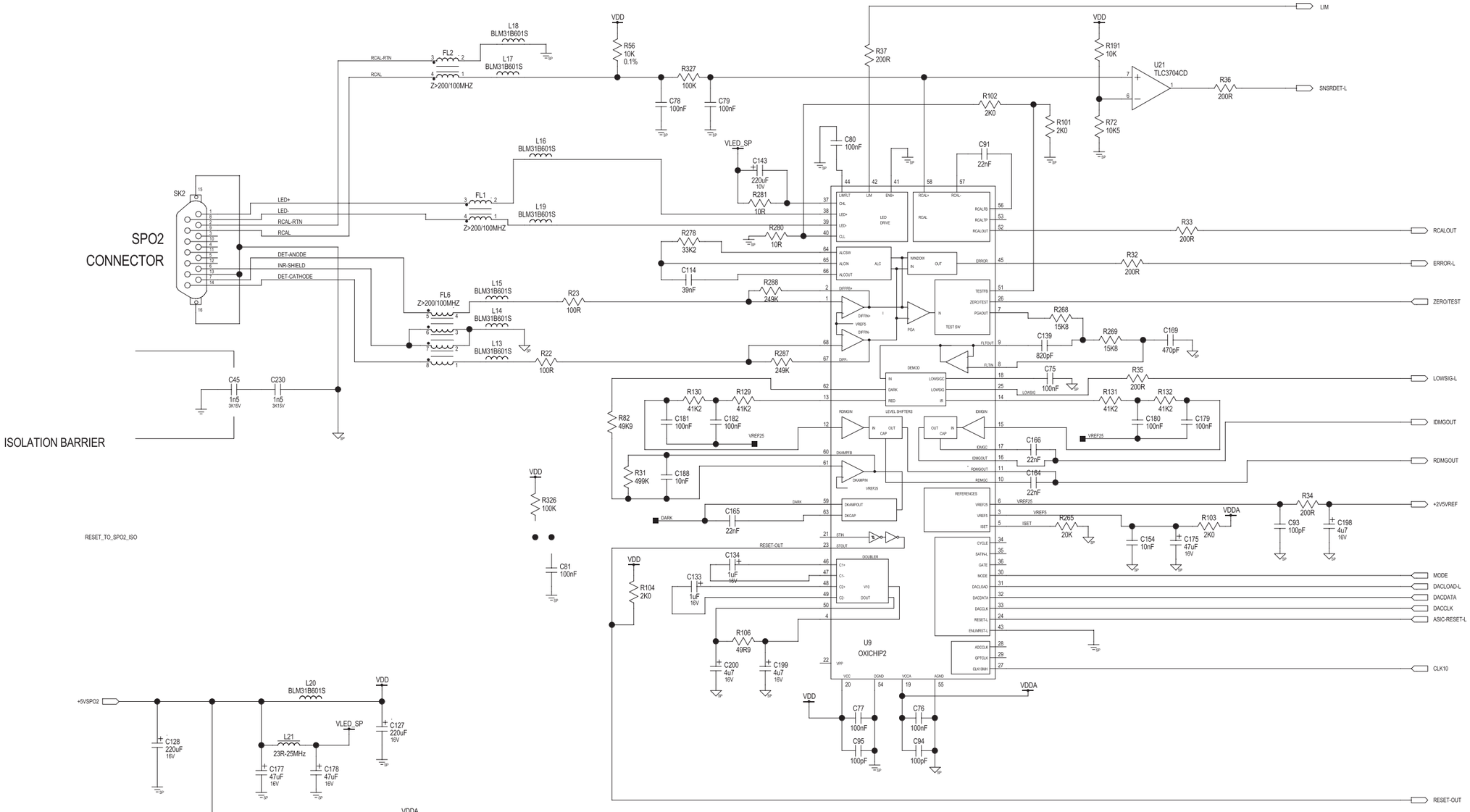


POWER CONNECTOR



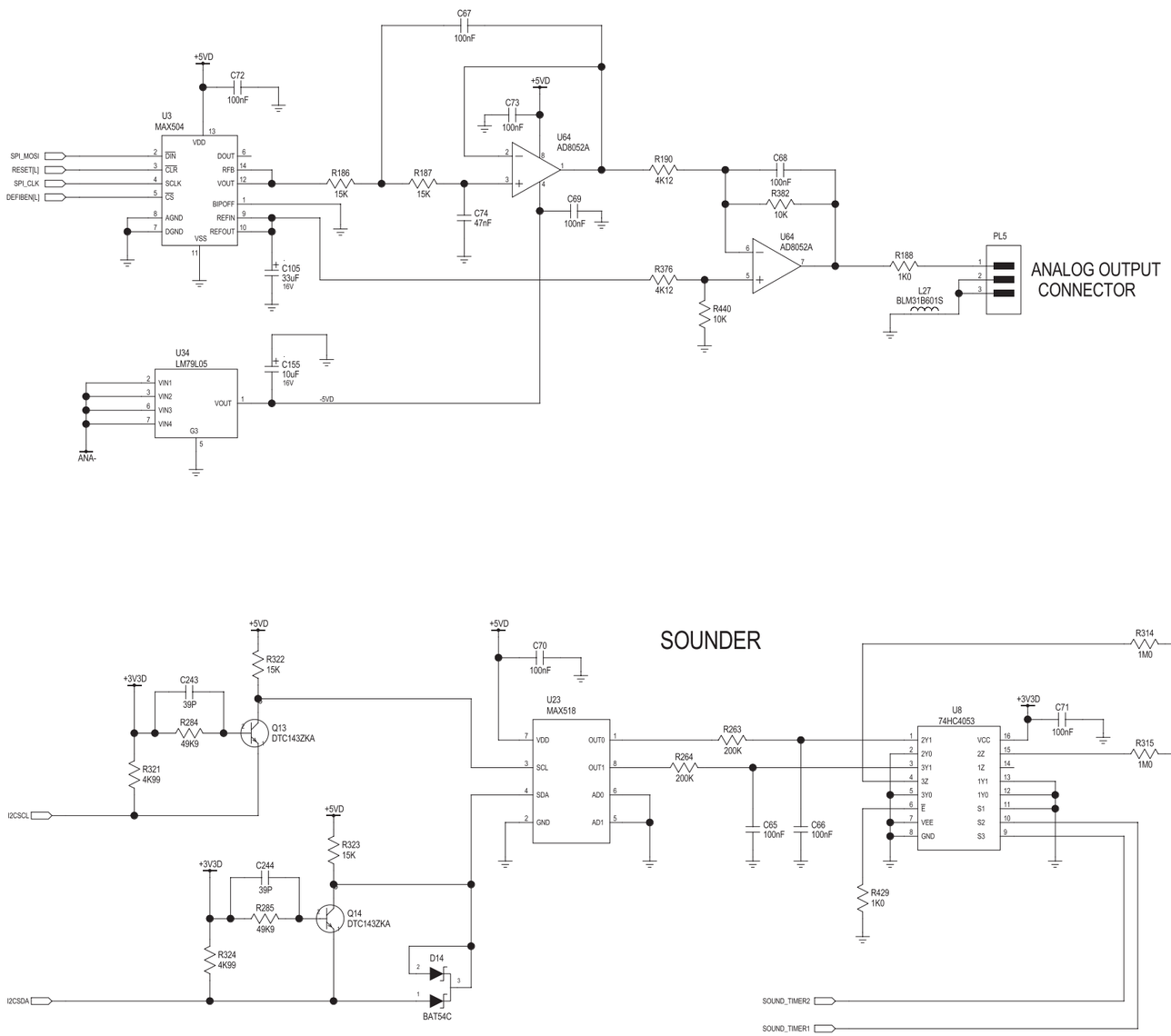
LCD BACKLIGHT CONNECTOR

Schematic - Main Board
P/N 315592 (9 of 12)

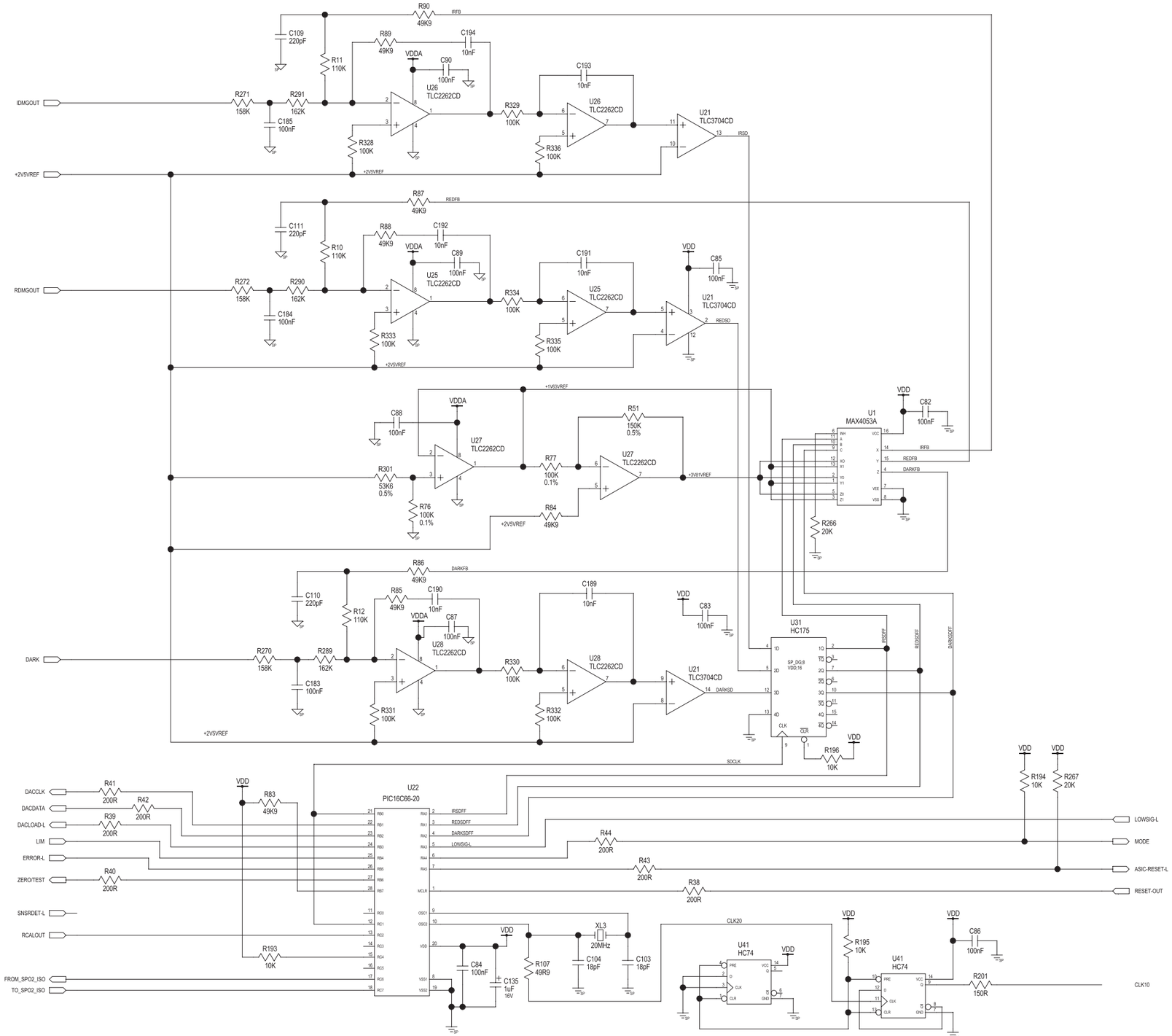


Schematic - Main Board
P/N 315592 (11 of 12)
Page 5-39/40

ANALOG OUTPUT



SOUNDER



Schematic - Main Board
P/N 315592 (12 of 12)
Page 5-41/42

MAINS AC/DC MODULE

EXTERNAL DC +12V TO +32V

PL4

PL3

D13 PBYR1045

D12 PBYR1045

FS2 5A0

C22 100nF

D11 SM6T39CA

C23 100nF

R4 110K

R75 10K7

C24 100nF

R17 10M 5%

+5V

R93 127K

R30 47K5

VDC_OP

U12 LM339

BATTERY_SWITCH (SHT. 2)

DC_INPUT (SHT. 4)

C75 470uF 50V

C76 470uF 50V

+12V_+32V (SHT. 2)

U2 LM2931D2T

+VIN OUT SHDN ADJ GND

C25 100nF

R33 1K0

R64 9K09

C73 47uF 16V

+12V_IN (SHT. 2)

D10 BAV70

C74 47uF 16V

C51 1uF 35V

U17 LT1339

SYNC 5VREF CT SL/ADJ IAVG SS VC SGND VFB VREF

VBOOST TG TS 12VIN BG PGND PHASE RUN/SHDN SENSE+ SENSE-

R3 16K9

C53 1uF 16V

C10 1nF

R21 0R0

C54 330pF

C11 1nF

R45 10K

C14 100nF

R34 1K0

R74 10K7

C99 10nF

R24 0R0

R87 100K

Q15 PHP21N06T

Q16 PHP21N06T

D2 RB160L-40

D3 RB160L-40

L2 79uH

R5 0R022 1W

C6 470uF 35V

C7 470uF 35V

VDCIN (SHT. 2)

ET4 ET3 ET2 ET1

DTC143ZKA is a digital transistor with a 4K7 base resistor and a 47K base pull-down resistor

D12 , D13 , Q16 Require heatsink type F13-2-220D-2LS

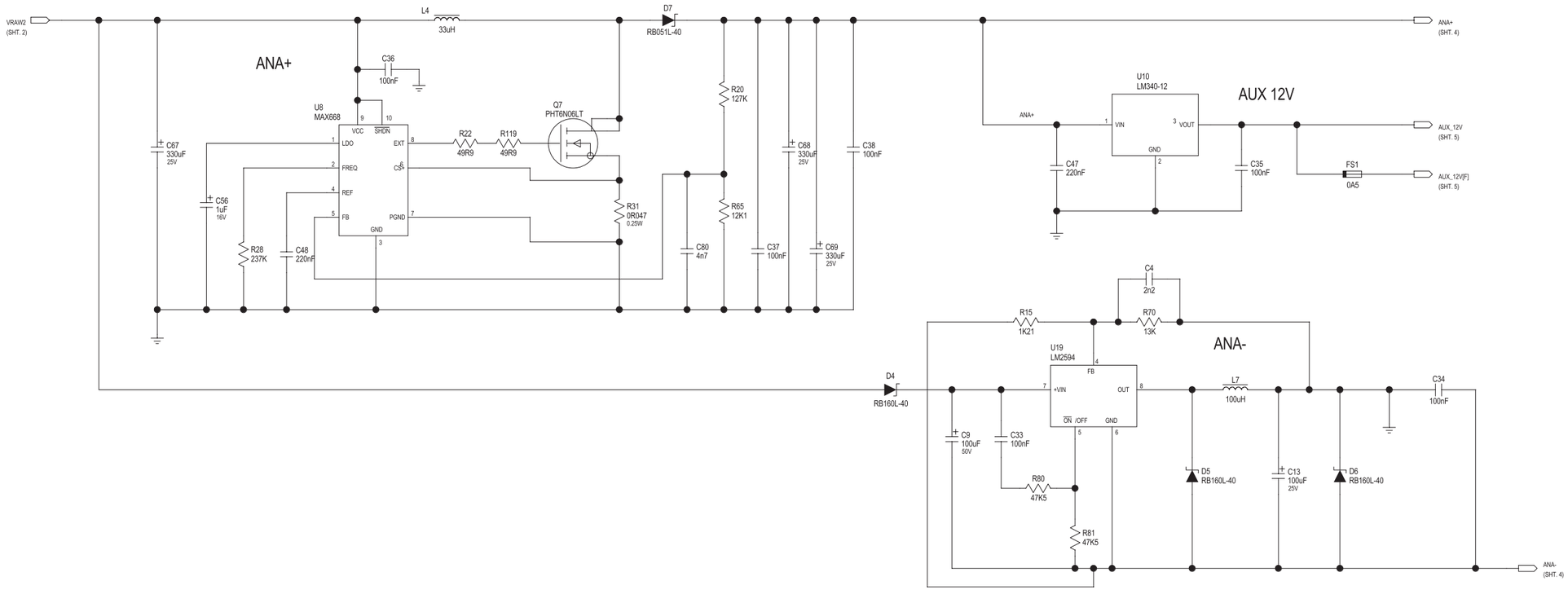
Q15 Requires heatsink type F14-2-220-2L

Schematic - PSU
P/N 315593 (1 of 5)
Page 5-43/44

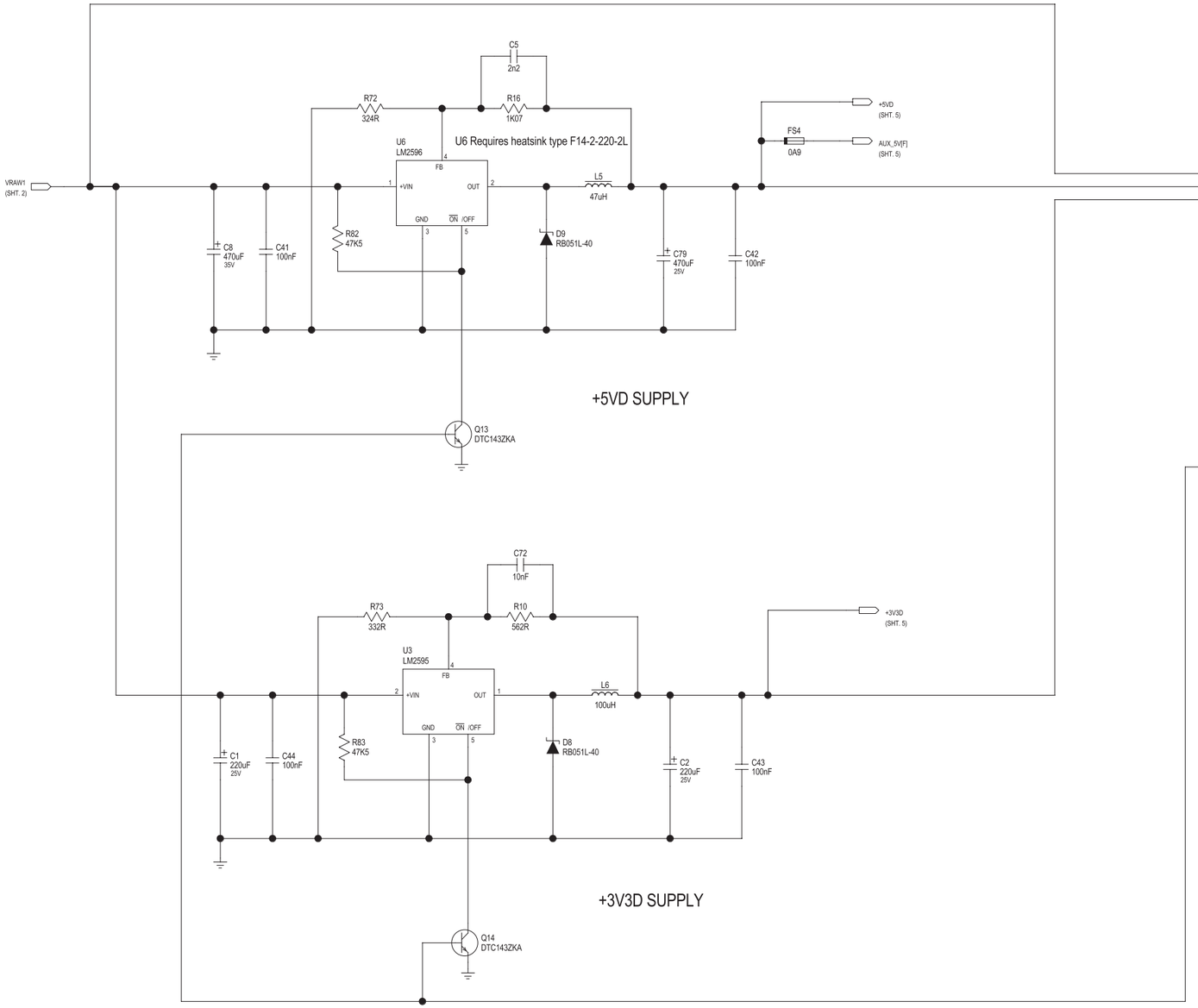
+12V_+32V (SHT. 1)
+12V_IN (SHT. 1)
C91 220uF 50V
C92 220uF 50V
C96 100nF
R44 2K67
R8 16K9
C86 1uF 16V
C30 1nF
U23 LT1339
SYNC
SVREF
CT
SL/ADJ
IAVG
SS
VC
SGND
VFB
VREF
VBOOST
TG
TS
12VIN
BG
PGND
PHASE
RUN/SHDN
SENSE+
SENSE-
C85 1uF 16V
C31 10nF
R51 10K
C78 100nF
R50 1K0
R101 14K3
R43 0R0
D16 BAV70
C84 1uF 35V
C90 47uF 16V
Q21 PHP21N06T
D15 RB160L-40
Q20 PHP21N06T
D14 RB160L-40
R104 100K
L1 149uH
R111 0R033 1W
D20 PBYR1045
C12 470uF 35V
R18 10K
C18 100nF
R94 3K32
VRAW
R105 100K
Q12 DTC143ZKA
Q17 DTC143ZKA
CHARGER_ON[H] (SHT. 4)
C15 100nF
C83 100pF
U16 LT1620CS8
VCC
SENSE
AVG
GND
IN+
IN-
PROG
IOUT
C97 100nF
C98 100nF
C100 10nF
U5 MIC2950-06BZ
VOUT
VIN
GND
+5V (SHT. 1)
C89 1uF 16V
C28 100nF
R103 100K
R99 47K5
R102 100K
D21 BAV70
C52 100nF
VDC_OP (SHT. 4)
Q2 IRF5305S
Q3 IRF5305S
VRAW1 (SHT. 3,4)
BATTERY_SWITCH (SHT. 1)
Q9 DTC143ZKA
ZVP3306F Q22
Q11 DTC143ZKA
BATT_OFF[L] (SHT. 4)
C55 100nF
VRAW
VDCIN (SHT. 1)
R112 0R010 1W
D19 PBYR1045
R14 100R
R13 100R
U11 MAX472
NC
RG1
SHDN
GND
RG2
VCC
SIGN
OUT
C17 100nF
R121 1K0
R95 9K09
C87 1uF 16V
R91 100K
C81 4u7 35V
MTD2955V Q6
VRAW2 (SHT. 3)
R90 100K
R9 39K2
Q10 DTC143ZKA
12V_ON[H] (SHT. 4)
FS3 5A0
FS5 0A5
VBAT (SHT. 4)
C77 100nF
FS6 BATTERY DISCONNECT
R113 0R010 1W
R19 100R
R25 100R
U13 MAX472
C103 22UF 50V
C26 100nF
R120 1K0
R58 10K
C88 1uF 16V
D29 BZX84C 5V1
C27 100nF
R106 100K
R100 10K
U24 PIC12C672-04SM
VDD
AN0
GP4
GP5
GP3
AN1
AN2
VSS
TRICKLE_CHARGE[L]
PL7
+ BATTERY
- BATTERY
- THERMISTOR
+THERMISTOR (33K @ 25 C)
BATTERY CONNECTOR
C29 100nF
CHARGE_STATUS (SHT. 4)
Q19 DTC143ZKA
Q1 FDV302P
R47 150K
R79 237K
R97 56K2
R78 1M0
U22 LM339
R56 10K
R1 53K6
R69 1M0
R98 33K2
R52 10K
R96 13K
R71 1M0
R89 26K7
R55 10K
R88 20K
R57 10K
Q18 DTC143ZKA

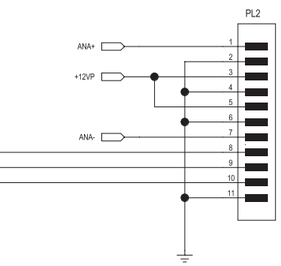
NiMH BATTERY CHARGER

Schematic - PSU
P/N 315593 (2 of 5)
Page 5-45/46

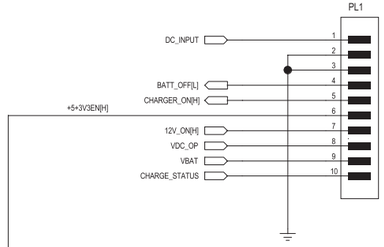


Schematic - PSU
P/N 315593 (3 of 5)
Page 5-47/48





POWER
CONNECTOR



POWER MONITOR
CONNECTOR

Schematic - PSU
P/N 315593 (4 of 5)

HOST INTERFACE

HOST CONNECTOR

COMMS CONNECTOR

WIRELESS CONNECTOR

PL5
HOST_RX2
HOST_TX2
TX1
RX1
REMOTE_ALARM[L]

U7 74HC14
+3V3D C94 100nF
R76 1K0
D25 BZX84C 5V1
R77 1K0
D26 BZX84C 5V1
R86 47K5
R84 47K5
D22 BZX84C 5V1
R40 1K0
R41 1K0
D23 BZX84C 5V1
R38 1K0

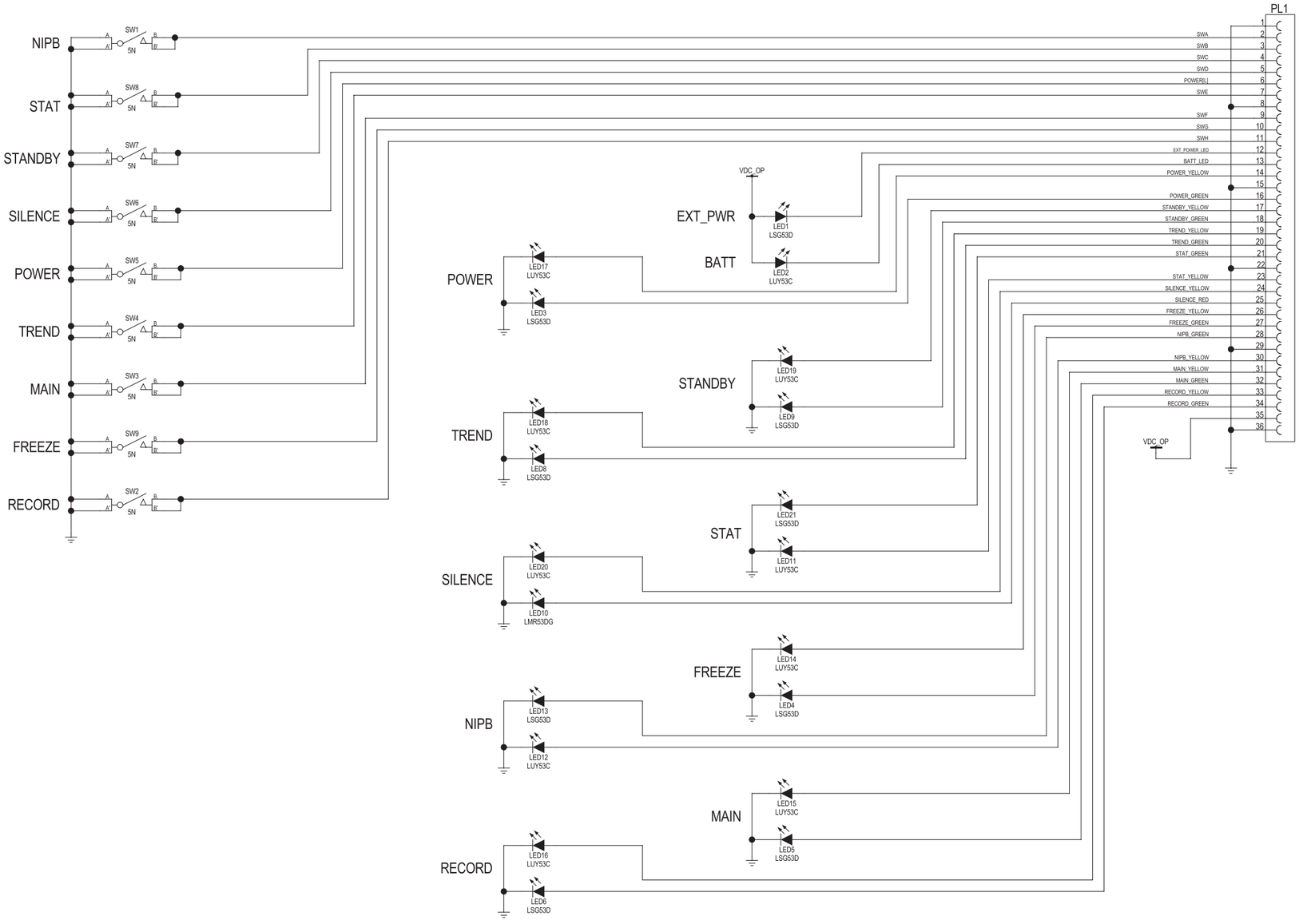
U15 HC240
C45 100nF
U15 HC240
U7 74HC14

U20 MAX3221E
C58 1uF 16V
C60 1uF 16V
C59 1uF 16V
C61 1uF 16V
C62 1uF 16V
VCC
C1+
C1-
C2+
C2-
V+
V-
T1IN
T1OUT
R1OUT
R1IN
EN
INVALID
FORCEON
FORCEOFF
GND

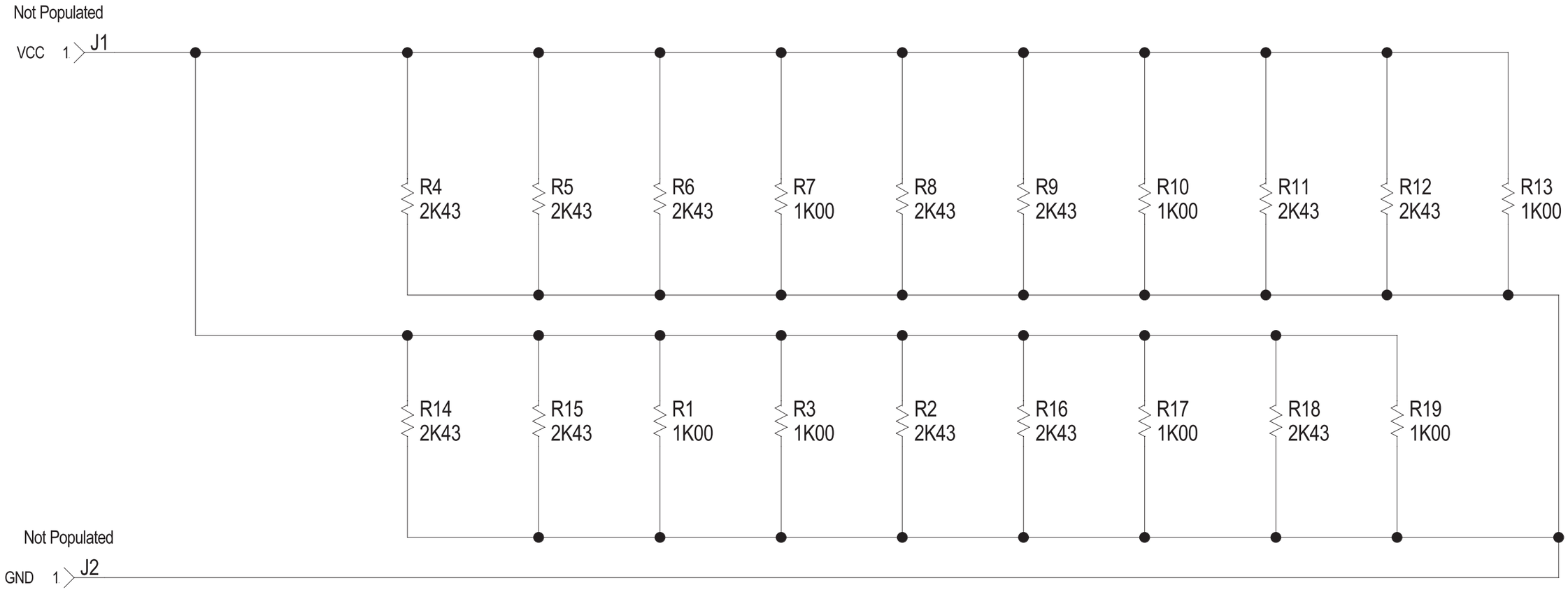
U1 HC02
ENABLE_AND_TTL
ENABLE_AND_RS232
-ENABLE
-RS232
R53 10K
R54 10K
R35 1K0
R36 1K0
D27 BZX84C 5V1
D28 BZX84C 5V1
C95 100nF

SK2
(SHT. 4) +5VD
(SHT. 3) AUX_12V[
C49 10uF 16V
AUX_5V[F]
C50 10uF 16V
AUX_12V[F]
R114 1K0
R39 1K0
R85 47K5
D24 BZX84C 5V1
LK1
SK1
GND2

FS7 0A5
Q4 PHT6N06LT
D1 SM6T15C
D32 BZX84C 5V1



Schematic - Keyboard
P/N 315594 (1 of 1)
page 5-53/54



Schematic - Probe Warmer
P/N 315595 (1 of 1)
page 5-55/56